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Gear marking pilot study in Indonesian small-scale gillnet fisheries with reference to FAO's draft Guidelines on the Marking of Fishing Gear

Executive Summary

This report describes a pilot project to test means and methods of marking gillnets in accordance with FAO's Draft Guidelines on the Marking of Fishing Gear ('the Draft Guidelines') and to explore the scope for a retrieval and recycling scheme. The pilot study was conducted in Indonesia small-scale gillnet fisheries. The study found that the availability of environmentally friendly materials for markers and fisher safety when operating gear with physical markers were both key issues. The study also found that gear marking must be implemented in the context of broader measures for managing fishing gear and wider fisheries management measures as gear marking alone is unlikely to solve the issues of abandoned, lost or otherwise discarded fishing (ALDFG) and ghostfishing that are apparent in Indonesian small scale-scale and probably other similar fisheries, particularly in developing countries. Such measures could include fisher education and awareness raising, capacity building in general, spatial management of fishing effort and a circular economy approach to managing end-of-life gear.

ADVANCE COPY

FAO Fisheries and Aquaculture Technical Paper

GEAR MARKING PILOT STUDY IN INDONESIAN SMALL-SCALE GILLNET FISHERIES

WITH REFERENCE TO FAO'S DRAFT GUIDELINES ON THE MARKING OF FISHING GEAR

by

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PREPARATION OF THIS DOCUMENT

At the 31st session of the Committee on Fisheries (COFI) held in 2014, concern was expressed about ghost fishing by abandoned, lost or otherwise discarded fishing gear (ALDFG). COFI recommended that Members and regional fishery bodies (RFBs), including regional fisheries management organizations (RFMOs), increase attention to mitigating ALDFG impacts, noting that cost-effective technologies and practices were available. In response, in 2016, the Food and Agriculture Organization of the United Nations (FAO) convened an Expert Consultation on the Marking of Fishing Gear, resulting in the development of *Draft Guidelines for the Application of a System on the Marking of Fishing Gear*. Upon considering the recommendations of the Expert Consultation, COFI, at their 32nd Session in 2016, encouraged FAO to support the implementation of the Draft Guidelines by conducting pilot projects on fishing gear marking. COFI also supported the further development of the Draft Guidelines via a Technical Consultation on the Marking of Fishing Gear, which was convened in February 2018. To implement COFI's recommendations and support the work of the Technical Consultation on the Marking of Fishing Gear, in 2017, FAO conducted a pilot project on the marking of gillnets in small scale fisheries in Indonesia to provide further information to support the future implementation of the FAO Draft Guidelines. This report documents the work carried out in collaboration with World Animal Protection[1].

[1] World Animal Protection provide the Secretariat for the Global Ghost Gear Initiative (GGGI)

FAO. 2018.

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Gear Marking Pilot Study in Indonesian Small-Scale Gillnet Fisheries with Reference to FAO's Draft Guidelines on the Marking of Fishing Gear

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ABSTRACT

Abandoned, lost or otherwise discarded fishing gear (ALDFG) remains a growing issue of concern globally and gear-marking may be an important tool to combat ALDFG and its harmful impact. In response to a request by the Thirty-First Session of the Committee on Fisheries (COFI 31), FAO convened an Expert Consultation on the Marking of Fishing Gear in April 2016, resulting in the development of *Draft Guidelines for the Application of a System on the Marking of Fishing Gear*. At their 32nd Session in 2016, COFI encouraged FAO to conduct pilot projects related to ALDFG and gear marking in developing countries. The purpose of this project was to test means and methods of marking gillnets in accordance with FAO's *Draft Guidelines on the Marking of Fishing Gear ('the Draft Guidelines')* and explore the scope for a retrieval and recycling scheme. The pilot study was conducted in Indonesia. The study found that the availability of environmentally friendly materials for markers and fisher safety when operating gear with physical markers were both key issues. The study also found that gear marking must be implemented in the context of broader measures for managing fishing gear and wider fisheries management measures as gear marking alone is unlikely to solve the ALDFG and ghostfishing issues that are apparent in Indonesian small scale-scale and probably other similar fisheries, particularly in developing countries. Such measures could include fisher education and awareness raising, capacity building in general, spatial management of fishing effort and a circular economy approach to managing end-of-life gear.

EXECUTIVE SUMMARY

Background

Abandoned, lost or otherwise discarded fishing gear (ALDFG), sometimes also known as “ghost gear”, accounts for approximately 10% of marine debris and has serious impacts on marine wildlife, habitats and fish stocks. ALDFG may result in reduced fishing profits when it continues to fish (‘ghostfishing’) and destroys marine resources, and results in increased operational costs for vessel owners/operators and authorities through the gear replacement and retrieval efforts. ALDFG also represents a navigational and safety-at-sea hazard.

Fishing gear has been abandoned, lost or otherwise discarded since the earliest time when fishing began, but extensive use of low-cost, durable and non-degradable synthetic materials in fisheries worldwide since the 1960s has dramatically accelerated and intensified its impact. The overall increase in fishing capacity and fishing on more distant and deep fishing grounds have further escalated the loss and abandonment of fishing gear.

Gillnets, pots and fish aggregating devices (FADs) are some of the most likely gear types to become ghost gear, and consequently have the most severe impact on mortality and welfare of marine species. Gear marking has been identified as a tool which can assist in the effective management of fisheries, prevent and reduce ALDFG, and combat illegal, unreported and unregulated (IUU) fishing. Gear marking is already referenced in FAO’s Code of Conduct for Responsible Fisheries.

Action from FAO’s Committee on Fisheries (COFI)

ALDFG remains a growing issue of concern globally. In response to a request by the Thirty-first Session of the Committee on Fisheries (COFI 31), FAO convened an Expert Consultation on the Marking of Fishing Gear in April 2016, resulting in the development of *Draft Guidelines for the Application of a System on the Marking of Fishing Gear (“the Draft Guidelines”)*. At their 32nd Session in 2016 the Committee on Fisheries (COFI 32) welcomed FAO’s work on abandoned, lost or otherwise discarded fishing gear, supported a Technical Consultation to continue developing the FAO Draft Guidelines and encouraged FAO to conduct pilot projects to mitigate ALDFG and ghostfishing, including retrieving ALDFG and marking fishing gear, particularly in developing countries.

To implement COFI’s recommendations and support the upcoming Technical Consultation, a pilot project was implemented in Indonesia focusing on small-scale gillnet fisheries. The purpose of the project was to test means and methods of marking gillnets as proposed in the Draft Guidelines and explore the scope for a retrieval and recycling scheme.

Indonesia was proposed as the region for the project due to severe issues of marine debris, including ALDFG, known to originate there, coupled with increased threat of IUU and the stated recognition and willingness of the Indonesian government to take steps towards addressing it.

Aims for marking gillnets

Gillnets were proposed as a primary focus of the project due to their prevalent loss and impact as ALDFG. Gillnets, designed to catch fish by gilling and entangling around their gills, make up a significant proportion of global marine fisheries landings. Gillnet is recognised as one of the most damaging types of fishing gear if not managed properly as it is able to maintain high ghostfishing catch rates for long periods, years in some cases, if it becomes ALDFG.

Two pilot sites were selected in Java, Indonesia, to test marking methods outlined in the Draft Guidelines. Both sites were selected due to their distinct characteristics. In Pekalongan, low rates of gear loss were reported due to favourable weather conditions and a sandy, muddy substrate which reduces the possibility of snagging. In Sadeng, where fishers operate gillnets in deeper waters in the Indian Ocean in less favourable weather conditions, higher rates of gear loss were reported, with one study estimating 30,000 pieces of gillnet being lost each year in the spiny lobster gillnet fishery (FAO, 2017).

The project aimed to identify whether the marking of gillnets is both practically possible in the context of this type of fishery and whether it would serve as a useful component of a strategy to address the challenges of ALDFG and IUU in the region by identifying ownership and location of fishing gear.

Current practices

Due to the low cost of gillnets and a government subsidy programme providing nets to fishers there is limited incentive to retrieve lost nets in both project sites, although repair and reuse of damaged nets is commonly reported. In the two pilot sites, and in similar small-scale fisheries in Indonesia, fishers are already using flashlights and flags to increase visibility of fishing gear to enable location by the fishers themselves and to avoid conflict with other fishing vessels. Gillnets are usually marked with a flag at the beginning and end of the fleet. The current methods are not sufficient to meet requirements of what is outlined by the FAO Draft Guidelines, particularly with regards to marking for the purpose of identification of ownership. There are ministerial regulations related to the management of oceanic drift gillnets which cover mark buoys to assist in locating nets. There is a stated desire amongst stakeholders in the fisheries to improve the current practices, particularly for gillnets.

Pilot project

Survey information in the pilot sites determined the requirements for the marking study, which took place in the latter half of 2017. An overarching aim of the pilot project was to test means and methods of marking gillnets as proposed in FAO's Draft Guidelines and to provide preliminary findings and recommendations for the consideration of the FAO's Technical Consultation on the Marking of Fishing Gear in February 2018. Another key objective of the pilot project was to gain knowledge and understanding of the issue that may be applicable to other comparable locations and fisheries.

The requirements of the study were to find low-cost marking methods which could be easily applied and would not interfere with fishing operations. Another key consideration was to consider the potential impact of pollution of lost gear markers and their durability in a dynamic salt-water environment.

Existing information about trends and abundances of lost gillnets in the region is sparse, with information previously being collected via face to face interviews. There is a lack of survey or industry data. The pilot project collected baseline information via consultation with the fishing community to identify current practices of marking, causes of gear loss and practical challenges to the retrieval of lost gear.

Gillnets were marked using a variety of methods including metal, plastic, bamboo, coconut shell and FibreCode tags which were then assessed using a multi-criteria analysis to determine the preferred method. Following a project review workshop, FibreCode marking method was considered as the preferred method. Further studies are required to explore embedding of fibres into non-plastic materials so that the codes could still be read using a mobile phone but without pollution risk if lost.

Considerations for implementing a gear marking system

The study concluded that, in general, small-scale fishers were cooperative and supportive of gear marking initiatives. However, there is a need for greater understanding of the benefits of gear marking. Further work should be done on related issues, particularly the ability to retrieve the gear when it became lost.

Implementing gear marking within the context of a small-scale gillnet fishery, such as those that have been subject to this trial in Indonesia, is possible providing that a holistic implementation plan is in place encompassing capacity building and related support, data collection, fisher education and incentives. There is a recognized appetite for a multi-pronged approach to address ALDFG and IUU fishing through prevention, mitigation and cure.

There may be some challenges to applying certain types of technology in the context of both small-scale fisheries in general, and gillnet fisheries in particular, due to the cost of more technical marking options and the comparative low value of the gear itself. Marking at manufacture and adding value to end-of-life gear could be potential approaches to address these issues.

Availability of environmentally friendly materials for markers and their attachments, and fisher safety when operating physically marked gear were both key issues that arose during this project. Further guidance on these aspects within the gear marking guidelines may be helpful.

Fishers in the pilot sites were mostly not using the gear subsidised by the government so the previously envisaged approach to mark gear at manufacture level and distribute it via the subsidy programme as a route to test gear marking was not possible. Marking fishing gear at manufacture level via collaboration with both the government and private sector is therefore recommended for any future projects.

Gear marking must be implemented in the context of broader measures for managing fishing gear and managing fisheries. Without due consideration of the wider framework of measures, gear marking alone is unlikely to solve the issue of ALDFG that are prevalent in Indonesian small scale-scale and probably other similar fisheries, particularly in developing countries. Such measures should include fisher education and awareness raising, capacity building in general, spatial management of fishing effort and a circular economy approach to managing end-of-life gear.

CONTENTS

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ACRONYMS

ALDFG	Abandoned, lost or otherwise discarded fishing gear
CFR	Centre for Fisheries Research
COFI	Committee on Fisheries
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DGCF	Directorate of Fishing Vessels and Gears
FAD	Fish Aggregating Device
FAO	Food and Agriculture Organization of the United Nations
GGGI	Global Ghost Gear Initiative
IMO	International Maritime Organization
IPB	Agricultural University Bogor
IUU	Illegal, unreported and unregulated (fishing)
MARPOL	International Convention for the Prevention of Pollution from Ships
MMAF	Ministry of Maritime Affairs and Fisheries
PCA	Principle component analysis
UNEP	United Nations Environment Programme
WAP	World Animal Protection
WWF	World Wildlife Fund

1. Introduction

1.1. Abandoned, Lost or Otherwise Discarded Fishing Gear

Human-originated marine debris is recognized as a major threat to marine animals globally (Hardesty et al., 2014; Vegter et al., 2014). Marine debris also damages marine environment, results in economic costs, and poses a navigational hazard and risk to safety at sea (FAO, 2009). While much of the debris accumulating in our oceans originates from land-based sources, abandoned, lost or otherwise discarded fishing gear (ALDFG), sometimes also known as 'ghost gear' accounts for approximately 10% of marine debris and is one of the major threats to marine wildlife (Macfadyen et al., 2009; Werner et al., 2016). In 2009, the United Nations Environment Programme (UNEP) and the Food and Agricultural Organization of the United Nations (FAO) estimated that about 640,000 tonnes of ghost gear is added to our oceans every year - it is likely that this number is now even higher (Macfadyen et al., 2009; Werner et al., 2016). Even within relatively small areas, the amount of ghost gear can be staggering.

Fishing gear has been abandoned, lost or otherwise discarded since the earliest time when fishing began, but extensive use of low-cost, durable and non-degradable synthetic materials in fisheries worldwide since the 1960s has dramatically accelerated and intensified the problem and its impact. The overall increase in fishing capacity and fishing on more distant and deep grounds have further escalated the problem.

Gillnets, pots[2] and fish aggregating devices (FADs) are some of the most likely gear types to become ghost gear, and the deadliest when they do, according to the Global Ghost Gear Initiative's (GGGI) Best Practice Framework (Global Ghost Gear Initiative, 2017a). When compared to other forms of human-caused marine debris, ghost gear poses the most danger to marine animals (Wilcox et al., 2016). Through entanglement, ghost gear is four times more likely to impact marine life than all other forms of marine debris combined (Wilcox et al., 2016).

Gear loss and ghostfishing have significant economic impact on fisheries. Ghost gear catches and kills fish which would otherwise form a part of legal, monitored catch, in some cases worth millions of dollars. Gear replacement costs also negatively affect fisheries in a variety of ways, including gear replacement and repair costs, and loss of fishing time. Economic impact studies show fisheries can be negatively affected by a variety of factors, including costs of replacing lost gear, and reduced populations of target species due to mortalities resulted from ghostfishing (NOAA, 2015).

1.2. Gear marking

To combat ALDFG, the marking of fishing gear has been proposed as a management tool by FAO and its Member States. Gear marking and ALDFG are already referenced in several international instruments including the 1995 FAO Code of Conduct for responsible Fisheries. Despite the existence of these instruments, ALDFG remains a growing issue of concern globally as very few governments, even fewer in developing countries, have fully implemented requirements for gear marking into their national

[2] The words "pot" and "trap" are often interchangeably used in literature. In this document, the word "pot" is used and refers to small baited enclosures that catch and retain fish and invertebrates, and includes many gear that is often referred to as "trap".

legislation. Therefore, it is prudent to conduct some field tests on the proposed gear marking guidelines, especially in developing countries.

Gear marking has numerous benefits. It is important to identify the owner, and to increase visibility of passive surface gear (Gilman, 2015). Appropriately marked fishing gear also provides important information for tracing the origin of gear components associated with entanglement of marine species (FAO, 2016). In addition to ownership, gear marking is also important to indicate its position, to allow other fishing vessels, control authorities and maritime traffic to avoid fishing gear that has been deployed (FAO, 2016). Furthermore, marking to identify ownership can create a disincentive for the deliberate abandonment of unwanted gear. It can provide an incentive to retrieve lost gear, and facilitate enforcement actions for monitoring and controlling ALDFG (Gilman, 2015). Identification markers may also enhance the fisher's sense of personal responsibility (Hager, 2005).

In response to the request by the Thirty-first Session of the Committee on Fisheries (COFI 31), FAO convened an Expert Consultation on the Marking of Fishing Gear in April 2016. This Expert Consultation produced Draft Guidelines on the Marking of Fishing Gear, taking into account new and emerging technologies for the marking of fishing gear and the issues relating to cost, feasibility and administration of a marking system. During the Thirty-second Session of COFI in July 2016, the Committee supported further development of the Guidelines via a Technical Consultation and also encouraged FAO to conduct pilot projects to facilitate the implementation of the guidelines, in particularly, in developing countries. One of the pilot projects was to test gear marking in gillnet fisheries in Indonesia.

1.3. Pilot project in Indonesia

Indonesia's capture fisheries have an important role in providing employment for Indonesian people. Between 2010 and 2014, approximately 6 million people were directly engaged in Indonesian fisheries each year, of which 2.7 million were employed in capture fisheries and 3.3 million were in aquaculture (FAO, 2016). The number of people employed in capture fisheries had increased by 58% between 2000 and 2014 (FAO, 2016).

Indonesia is a significant global producer of fish, from both wild capture fisheries and aquaculture. Production of marine capture fisheries is about 6 million tonnes and accounts for 7.4 % of the world's marine capture fisheries production (FAO, 2016). Indonesia has diverse aquatic resources, therefore seafood, wild-capture fisheries and aquaculture play important roles in trade, livelihoods, food security and culture (Stobutzki et al., 2014). Since 1990, Indonesia's fisheries production has increased by an average of 7% annually (Stobutzki et al., 2014).

The Indonesian archipelago is surrounded by Pacific Ocean and the Indian Ocean, with the characteristics of the two oceans strongly influencing the geographical condition of the marine environment. In marine capture fisheries, tuna account for the largest proportion by weight (20% of all production), followed by shrimp. Tuna species caught include bigeye, yellowfin, albacore, southern bluefin, skipjack and tongol (Stobutzki et al., 2014). Indonesia has a substantial problem with IUU catches (Varkey et al., 2010). This may be in part due to the fact that small-scale fishing, which accounts for a large proportion of fishing activities in Indonesia, remains largely unreported (Varkey et al., 2010).

Indonesia was proposed as a project site due to severe issues of marine debris, including ALDFG, coupled with increased threat of IUU and the willingness of the Indonesian government and other Indonesian stakeholders to take steps towards addressing it. The impacts of ALDFG originating in Indonesian waters reach far beyond Indonesia. Various studies in Australia have indicated that over three-quarters of fishing-related debris in Cape Arnhem, Northern Territory in Australia, is of southeast Asian origin, including Indonesia (Alderman, et al., 1999; Kiessling and Hamilton, 2001).

1.4. Gillnets

Gillnet fisheries were proposed as a primary focus of this project, due to their prevalence, risk and impact as ALDFG (Global Ghost Gear Initiative, 2017). Gillnets are important gear types worldwide and make up an estimated 19% of global marine fisheries landings (FAO, 2016a). Gillnets are generally size selective. Gillnets, designed to catch fish by gilling and entangling, have been found to be the most damaging type of fishing gear, along with trammel nets, if they become ALDFG. It is recognised that gillnets have high ghostfishing risk. Research has shown that lost or otherwise discarded gillnets and entangling nets can remain fishing at a high fishing capacity for long periods of time for both target and non-target species (Ayaz et al., 2006).

Small-scale fisheries, especially those in tropical coastal waters, possess great spatial and temporal variations, high diversity of gears and target species, and a variety of fishing activities. This makes fisheries management complex and challenging (Wiyono et al., 2006). In Indonesia about 80% of fishing activities are small-scale. Various types of fishing gear, from traditional to modern technology are used (Wiyono et al., 2006). Gillnets are of special interest to small-scale fisherman, due to their simple design, low investment, ease of operation and the lack of need for specialised boats or equipment for operation (Thomas, 2010).

1.4.1. Lobster gillnets

Gillnets which target lobster became a focus for this study in Sadeng due to the relatively high rate of their loss. Lobster catching season lasts for five to seven months each year, corresponding with the rainy season. It is estimated that approximately 30,000 pieces of lobster gillnet are damaged or lost annually in the Sadeng pilot site (FAO, 2017). The background study undertaken to inform this work also pointed to net loss estimates based on interviews with fishers in Southern Java which predicted losses of 80 panels of gillnet per year per fleet in the lobster gillnet fishery compared to between 2-5 panels per year in other gillnet fisheries in Java (Wudianto et al., 2017). This is due to the rocky and coral-dense environment of the lobster fishing area, strong current and unpredictable weather (Milton et al., 2014). Comparably the second pilot site in Pekalongan reported much lower rates of gear loss, potentially due to the sandy, muddy substrate reducing the risk of snagging and the more favourable weather conditions.

As an export commodity, lobster has a significant economic value. In 2017 alone, Indonesia exported approximately 1.3 million live lobsters, with estimated export value of USD 20 million. On the other hand, the domestic market is dominated by dead lobsters around which limited data is available since most of the lobster landing is not at fish auctions, but rather by direct transaction between fishers and lobster collectors (KKP, 2018).

Based on the depth of operation, lobster gillnets can be categorized into three types, namely:

- *Pepetan* lobster gillnet: fishing between 3 m and 5 m depth;
- *Tanggungan* lobster gillnet: fishing between 10 m and 25 m depth;
- *Tengahan* lobster gillnet: fishing between 70 m and 100 m depth.

Pepetan and *Tanggungan* lobster gillnet are essentially similar, each is about 73m long and 1.5m high. *Tengahan* lobster gillnet are a little bit higher at about 2.5 m high (Figure 1). Nets are made of monofilament twine of 0.35 mm diameter and 3.5 or 4 inch mesh size.

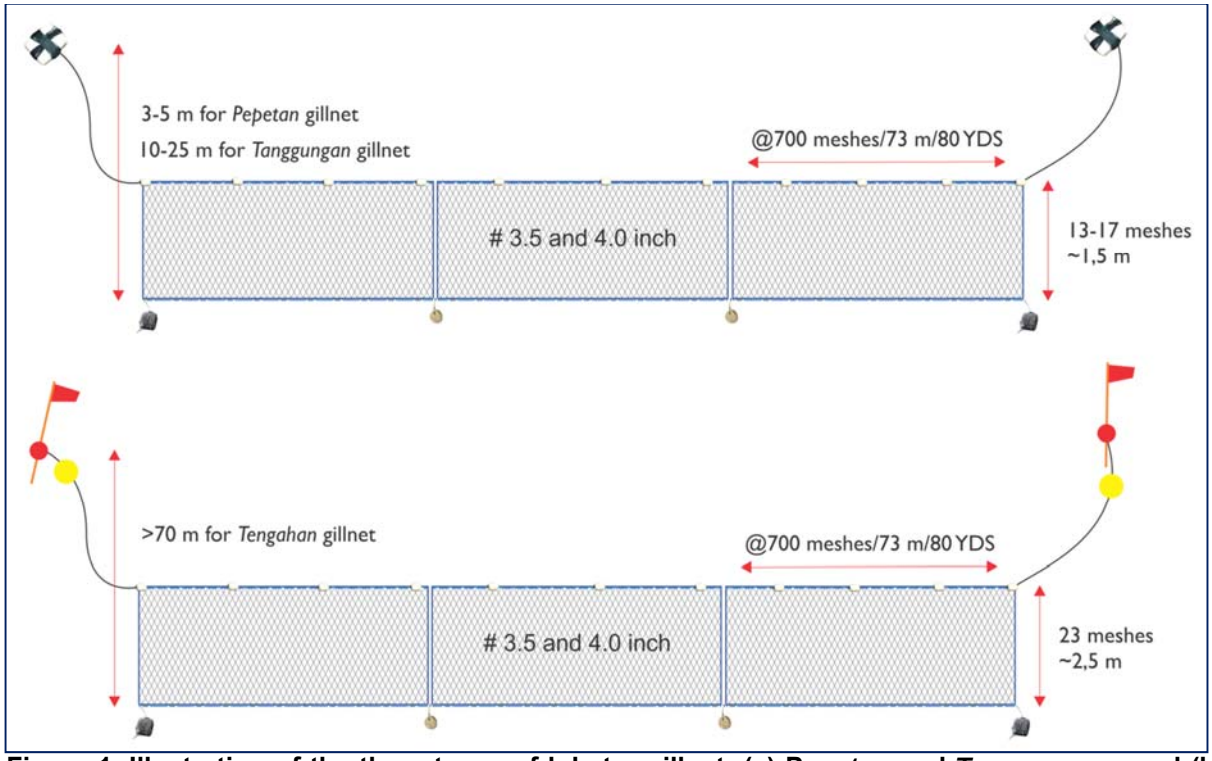

Figure 1. Illustration of the three types of lobster gillnet: (a) P*epetan* and *Tanggungan*; and (b) *Tengahan*.

According to interviews with fishers, the *Pepetan* gillnet catches are mostly dominated by rock lobster (*Panulirus penicillatus*), weighing about 0.5-1 kg. The *Tanggungan* gillnet catches are predominantly batik lobster (*Panulirus longipes*), as well as bamboo lobster (*Panulirus versicolor*), rock lobster (*P. penicillatus*), and sand lobster (*Panulirus homarus*), which weigh around 0.2-0.3 kg. The *Tengahan* gillnet catches are dominated by sand lobster, and some pearl lobster (*Panulirus ornatus*). The fishing area and bottom characteristics for each type of gillnet are illustrated in Figure 2.

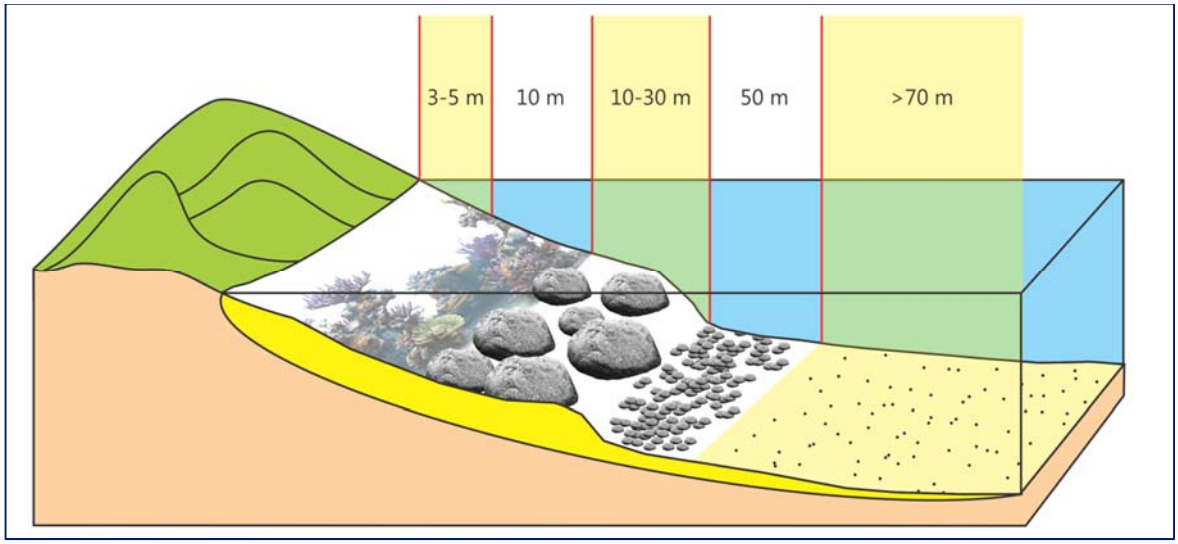

Figure 2. The *Pepetan* gillnet is operated within 3-5 m depth, which is situated next to the shore and cliff. The *Tanggungan* gillnet is operated within 10-30 m depth, while the *Tengahan* gillnet is operated at depths greater than 70 m.

In the Sadeng pilot site, there were approximately 50 boats with two to three fishers onboard. Each boat carries approximately 75 pieces of lobster gillnets per trip. The duration of fishing operation is one day. The gillnets were set during the day, either morning or afternoon, and the hauling was conducted at dawn the next day.

1.4.2. Fish gillnets

Gillnets used to target fish were also a focus of this study in the pilot site in Pekalongan, with slightly varying practices for setting, hauling and quantities compared to the lobster gillnets. In Pekalongan, there were approximately 50 boats using gillnets with four to five fishers onboard. Each boat carried about 30-40 pieces of gillnets per trip. The gillnets in the region were predominantly multi-monofilament and operated at both surface and bottom with adjustment depending on the target species and their behaviour, e.g., schooling. The gillnets were set during afternoons, while the hauling was conducted at dawn the next day. The setting time usually took an hour, with soak times ranging between 3-11 hours. Auxiliary equipment such as GPS navigation, line haulers and communication devices such as mobile phones were used during fishing operation. Fishing ground depth ranged from 30 to 50 m with a typically muddy and sandy-mud substrate as the main fishing environment.

Common species caught by this gear in Pekalongan included Spanish mackerel, bullet and frigate tuna, snakefish, mackerels, bumpnose trevally, snappers, barracudas, barred queenfish, stripped threadfin, sea catfish, pomfret, and splendid threadfin.

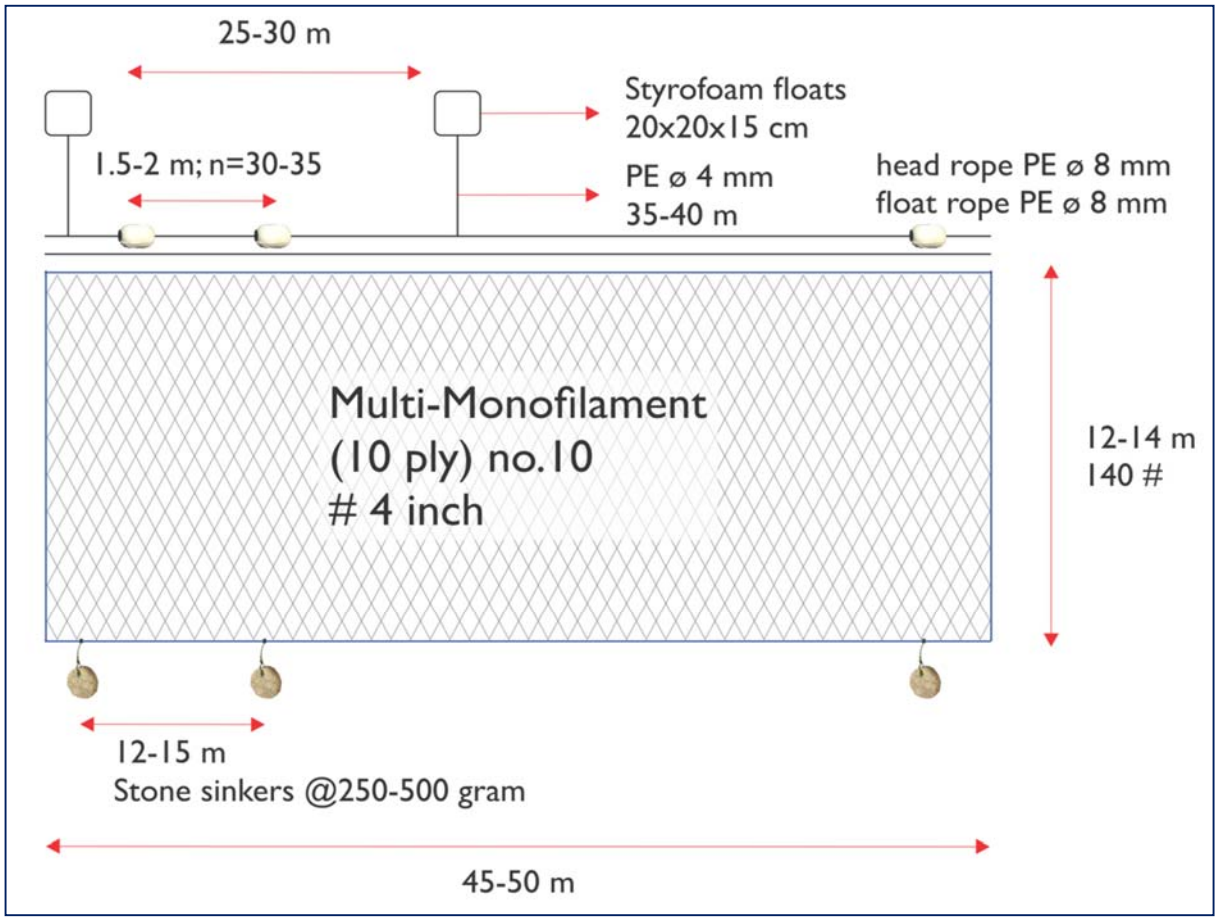

Figure 3. Illustration a piece of Pekalongan fish gillnet.

1.5. Project aims

At the request of FAO, a joint expert workshop was held in Jakarta, Indonesia in February 2017 to provide specific parameters for the pilot project to:

- Provide a practical case study to facilitate how the FAO's Draft Guidelines on the Marking of Fishing Gear could be implemented on gillnets and gather feedback on the practical application of the proposed marking techniques;
- Enhance technical understanding of Indonesian fisheries for how both static and drifting gillnets can be marked and tracked;
- Explore scope to implement measures from the Global Ghost Gear Initiative's (GGGI) Best Practice Framework, which outlines best practice to prevent, mitigate and cure the problem of ALDFG in the marine environment;
- Raise awareness of ALDFG in Indonesian fisheries at local and national level, and suggest approaches to address it;
- Gather data on the perception and impact of ALDFG in the identified fisheries that will feed into the GGGI data portal; and

- Explore the feasibility for retrieval and recycling of end-of-life fishing gear in the target fishery in a follow up phase of project.

Field work was undertaken in two pilot sites in Java, Indonesia from July 2017 to January 2018, to test approaches to marking gillnets. This work was reviewed at a Project Review Workshop in January 2018.

2. Methods

Two pilot sites were selected by the Centre for Fisheries Research based on previous research and existing links with fishing communities. Both sites were located in Java, one in Krapyak-Pekalongan (Java Sea) and the other in Sadeng-Yogyakarta (Indian Ocean) (Figure 4). An initial workshop was held in early 2017 to provide information to local participants in the trial on gear marking techniques and the context of the project.

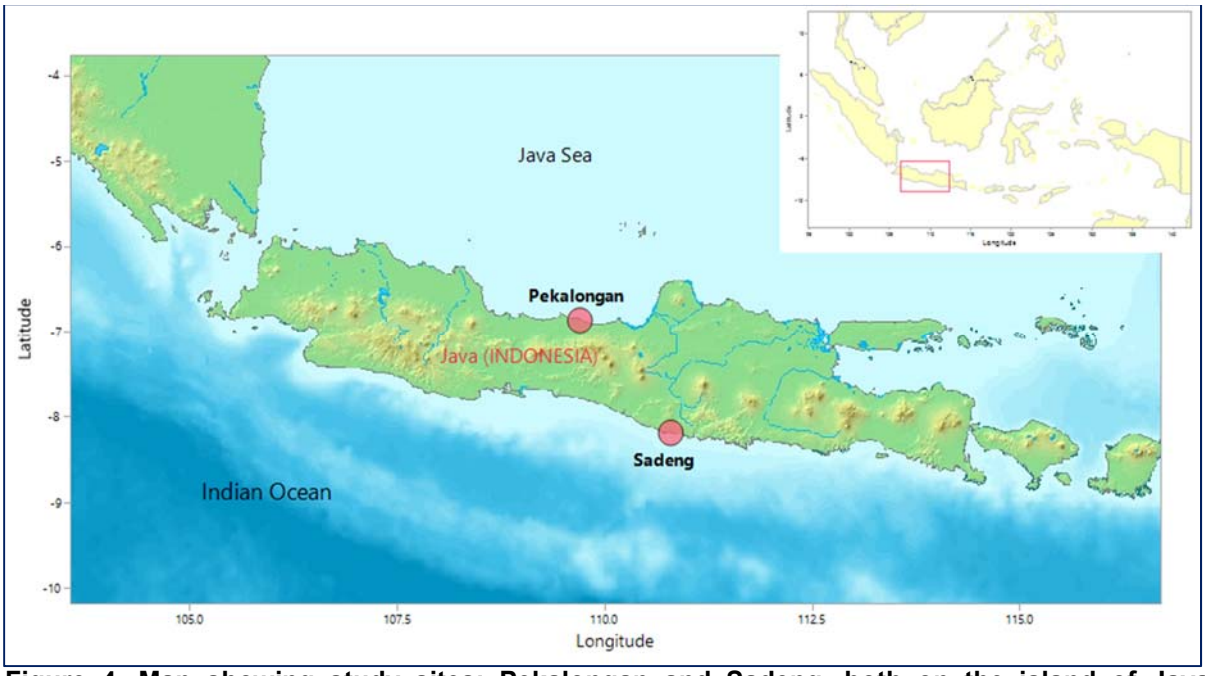

Figure 4. Map showing study sites: Pekalongan and Sadeng, both on the island of Java, Indonesia.

The research was conducted during 2017-2018 and was in three stages:

Stage one, July 2017

- Identifying current practice of gear marking used by gillnet fishers in the two pilot sites
- Identifying the fishing gear distributed by DGCF subsidy programme
- Conducting focus group discussions
- Identifying potential partners for the marking experiment

Stage two, November 2017

- Installing gear tags in the two pilot sites
- Mapping the gear lost in the hotspot areas
- Setting up including training local enumerators (community facilitators/data collectors) to collect information

Stage three, January 2018

- Evaluating and analysing collected data
- Interviewing fishers
- Conducting a review workshop with whole project team

One approach discussed during the initial workshop was to test the feasibility of marking gear at manufacturer level and then distributing marked gear through the government subsidy programme. However, the subsequent field research revealed that most small-scale fishers in the pilot areas were not using the gear from the government programme and therefore this would not be a viable route for distributing marked gear to those sites for the purposes of this pilot. Thus, the focus of the research became the testing of application, durability and efficacy of marking gear in the pilot sites rather than on ascertaining the practicality of an implementation system through an existing gear distribution process. Community enumerators (local field officers who collect a range of field data for fisheries) were recruited to collect data on the condition of the tags weekly and three visits from the project team were undertaken during the study duration to oversee data collection and supervise the project. Detailed reports on these visits can be found in Appendix 1 - 4.

Prior to field testing of the gear marking methods, interviews and focus group discussion were conducted in the pilot sites to collect information related to attitudes, behaviour and current marking practices.

Thirty fishers in each site participated in the in-person focus group discussions and from these fishers three boats for each location were selected for the field testing. The fishers participating in the focus groups were all men because while women in the communities have a role fixing and assembling nets they were not engaged directly in the fishing activity. The interviews were conducted in Bahasa and Javanese using the questionnaire in Indonesian (English version is attached in Appendix 5).

Methods tested for the marking of the gillnets were simple low-cost tags that were considered to be readily available in rural and developing world contexts and included a tag utilising FibreCode technology created by a commercial company (Septillion, Dunfermline, Scotland) that provides user-level identification upon scanning with a smart phone. The majority of tags were produced by Research Institute for Marine Fisheries and distributed to fishers. The FibreCode tags were obtained by World Animal Protection from Septillion with funding support from the Government of Netherlands.

The types of tag used in the experiment were:

1. Metal tag (M)
2. Yellow plastic tag (P)
3. Wooden tag (W)
4. Bamboo tag (B)
5. Coconut shell tag (C)
6. Septillion FibreCode tag (Sadeng only) (S)

All tags were required to have a readable printed unique ID. In this trial, *ID PKL 1 BRPL 2017* and *DIY 2 BRPL 2017* were used. The first part of the ID provided information about the location, for example “PKL” is an abbreviation for Pekalongan, “DIY” was used for Yogyakarta. The second identifier related to the type of gillnet that was being operated, for example “1” was used for surface gillnets and “2” for

lobster gillnets. BRPL was used to identify the institution involved and 2017 for the year of deployment of the piece of gear. The identification system developed for this pilot study was designed as simple as possible while still being able to deliver the marking purpose and provide information about the owner of the gear. It was noted by the research team that a more sophisticated identification could be designed as needed.

During the research, various activities were conducted to identify and potentially address ALDFG issues for small-scale gillnet fisheries as part of the development of the baseline during the project, as explained in Table 1.

Table 1. Site visits and activities involved.

Site visit	Trip	P	Activity
Kra (Pekalongan)	First (15-21	Erfind Nurdin Tri Wahyu Budiarti Hufiadi Baihaqi Agus Salim	1. Identifying gillnet fisheries 2. Focus group discussions 3. Identifying potential partners for the marking experiment
	Second (6-12	Erfind Nurdin Tri Wahyu Budiarti Hufiadi Baihaqi	1. Installing gear tags 2. Mapping the gear lost in the hotspot areas 3. Set up including training local enumerators (community facilitators/data collectors) to collect information
	Third (29	B	1. Evaluating and analysing collected data 2. Interviewing fishers

Sad (DI		First (20-24	Mahiswara Agustinus Widodo Andria Utama Hufiadi Baihaqi	1. Identifying gillnet fisheries 2. Focus group discussions 3. Identifying potential partners for the marking experiment
		Second (23-31	Mahiswara Erfind Nurdin Andria Utama Hufiadi Baihaqi	1. Installing gear tags 2. Mapping the gear lost in the hotspot areas 3. Setting up including training local enumerators (community facilitators/data collectors) to collect information
		Third (1-5	Hufiadi Andria Utama	1. Evaluating and analysing collected data 2. Interviewing fishers

In one site (Sadeng) tags were attached prior to the deployment of the gear. In the other site (Pekalongan) the tags were attached during operation. During the study, qualitative and quantitative data were collected from enumerators as well as during the field trips from the core project team. The data were processed using a multi-criteria analysis in Microsoft Exel in order to determine the strength and weakness of each type of tag. The six types of tag were assessed against twelve criteria (Table 2).

Table 2. Twelve criteria used in the tags assessment and the scoring system used to determine effectiveness.

No	CRITERIA	Score			
		1	2	3	4
1	Pollution effect	Very high	High	Middle	Low
2	Easy to unravel	Very difficult	Difficult	Middle	Easy
3	Cost of tag	Expensive	Cheap	Very cheap	
4	Availability of tag	Available in certain places	Order	Limited	Plenty
5	Manufacture	Difficult	Middle	Easy	
6	Practical installation	Very long	Long	Fast	Very fast
7	Durability of tag	fragile	Strong	Very strong	
8	Impact for net operation (disturb / annoying)	Very disturb	Disturb	Rather	Not
9	Safe for fishers	Low	Middle	High	Very high
10	Safe for fish catch	Not safe	Safe		
11	Accepted by fisher	Not accept	Accept		
12	Easy to monitor	Not visible	Not clear	Clear	Very clear

During the baseline research, gear conflict, snagging, and extreme weather conditions were identified as causes for the loss of gillnets in the pilot sites although the specific challenges in each pilot site were unique due to their contrasting environmental characteristics. Also identified during the baseline interviews was that the incentives for marking fishing gear were unclear to fishers. Despite this, attempts to retrieve lost gear using a drag and the repair or re-use of broken nets were reported as common practice. In particular, head ropes, sinkers and floats were re-used for assembling new fishing gear due to their higher value in contrast to the net itself. It was noted in the baseline interviews that damaged gear, in particular, the low-value portions of the nets, were thrown into the sea (Wudianto et al., 2017).

3. Results

3.1. Sadeng

The study on the marking of gillnets in Yogyakarta Province was conducted at the Coastal Fishing Port of Sadeng, Gunung Kidul, Yogyakarta (Figure 5). Three lobster gillnet boats participated in the experiment. Each boat operated one set of nets consisting of 25 pieces of lobster gillnet. Each piece was attached with an identification tag with a total of five variations of the different tags across each set of five pieces of lobster gillnet. The tags were attached alternately on the head rope and ground rope, except for the Septillion FibreCode tag, which was attached to the entire piece of net, with a total of 35 tags for 25 pieces of lobster gillnets. The fishing grounds of lobster gillnet fishery that are based in Sadeng Coastal Fishing Port are shown in Figure 5.

Figure 5. Location where fishing gear marking study was conducted. The yellow shaded area is the primary fishing ground for lobster gillnets. The areas enclosed by blue lines are the main area where lost or left nets were reported.

A critical component of the project was assessing the durability and effectiveness of the tags in a dynamic salt-water environment with frequent hauling of gear. The fishing gear marking experiment was carried out during a four-week period with three boats (A, B, and C). As shown in the table below Boat A reported that the numbers of yellow plastic tags (P) remained the same from the beginning until the end of experiment. The number of metal tags (M) lost were 20% and the legibility of numbers on them reduced as the experiment progressed. The percentage of Septillion FibreCode (S) tags lost was about 30% and about 60% wooden tags were lost. The worst results were for the bamboo tags (B) and coconut shell tags (C) as all were lost during the period. Boat B and boat C reported relative similar results (Figures 6 and 7).

Fishers	Tags	Number of days																													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
A	M	5								5			5		5		5	5			5		5	5							4		
	P	5								5			5		5		5	5			5		5	5							5		
	W	5								5			5		5		4	4			4		3	3							2		
	B	5								5			5		4		4	4			4		3	1							0		
	C	5								3			1		0		0	0			0		0	0							0		
	S	16		16	16			22		35	35							25															
B	M	5							5			5		5		5				5	5									5			
	P	5							5			5		5		5				5	5									5			
	W	5							5			5		5		5				4	4									2			
	B	5							5			5		5		5				5	4									0			
	C	5							5			5		4		2				0	0									0			
	S	10		20				20	20								0																
C	M	5										5		5	5						5	5						5					
	P	5										5		5	5						5	5						5					
	W	5										5		5	5						5	5						5					
	B	5										5		5	5						4	3						1					
	C	5										5		5	5						3	2						0					
	S	10						10	10						35																		

Figure 6. Retention of different markers during the four-week experiments with three fishers (M= metal; P= plastic; W=wood; B=bamboo; C=coconut and S= septillion).

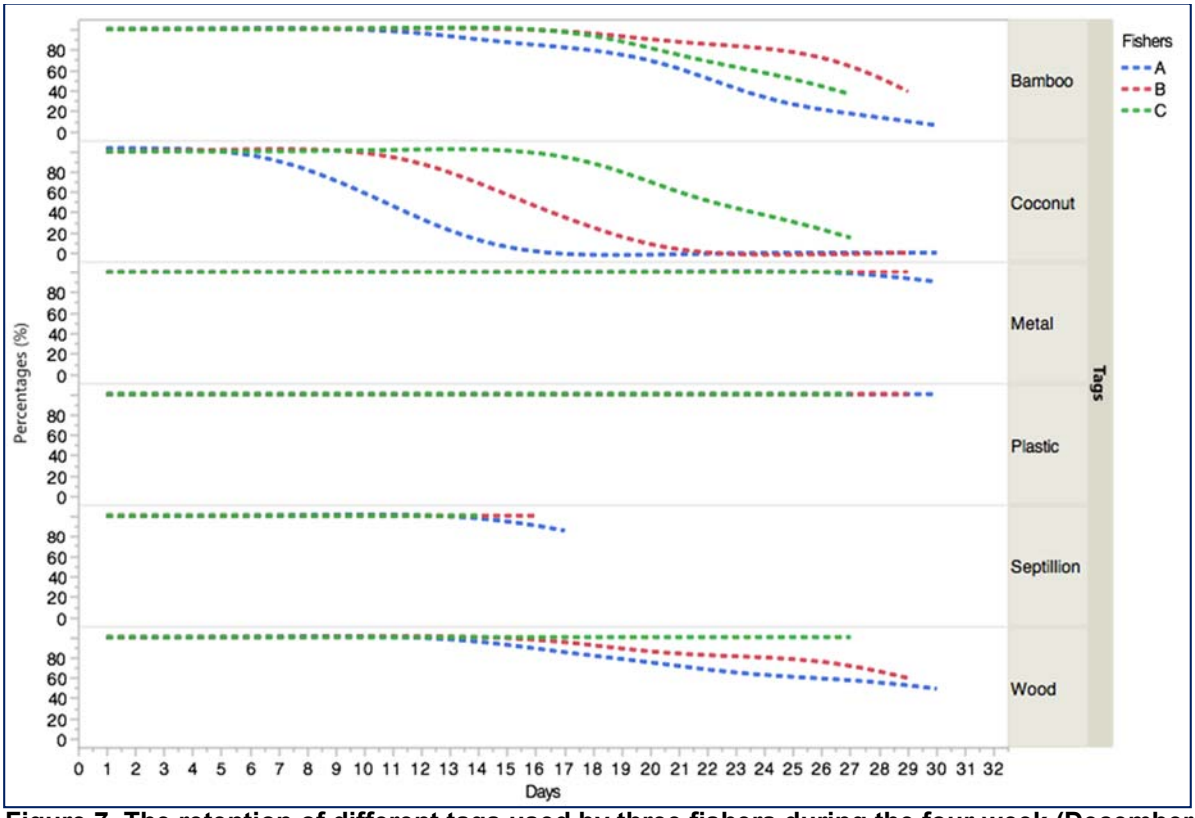

Figure 7. The retention of different tags used by three fishers during the four-week (December 2017) experiment.

Figure 7 shows that the coconut shell tag was the first to be lost, which was due to the material fastening the tag to the net breaking during the first week of experiment. Wooden and bamboo tags started to get lost or broken during the second week. The yellow plastic tag and Septillion tags showed the best retention during this period, potentially due to the plastic persisting better than the natural materials in the marine environment. Despite this, as many as 30% of the Septillion FibreCode tags were lost after two weeks, and it was observed that three days after the installation, material erosion occurred on the laminated plastic layer.

Principle component analysis (PCA) method was used for assessing their suitability considering various characteristics of tags (Figure 8). On the bottom-right quadrant in the diagram, the Septillion barcode tag scored highest for operational impact (A8) criterion, which means its use does not adversely affect fishing gear operation, is safe to be used by fishers (A9), cheap (A3), widely available (A4), and the most accepted by the fishers (A11) to be applied on their fishing gear. However, Septillion FibreCode tag has its weakness, for example, it does not dissolve easily (A2), and thus caused the most pollution as compared to bamboo tag, wooden tag, and coconut shell tag found on the upper-right quadrant of the diagram. In addition, the Septillion FibreCode tag is also more prone to breaking compared to the metal or yellow plastic tags, which can be seen on the upper left quadrant (A7). Eventually fishers refused to use tags other than the Septillion tags, since the other ones were so disruptive to fishing gear operation. Metal material was also considered dangerous. It can be concluded that the Septillion FibreCode tag was the most suitable with the criterion considered as compared to all other tags.

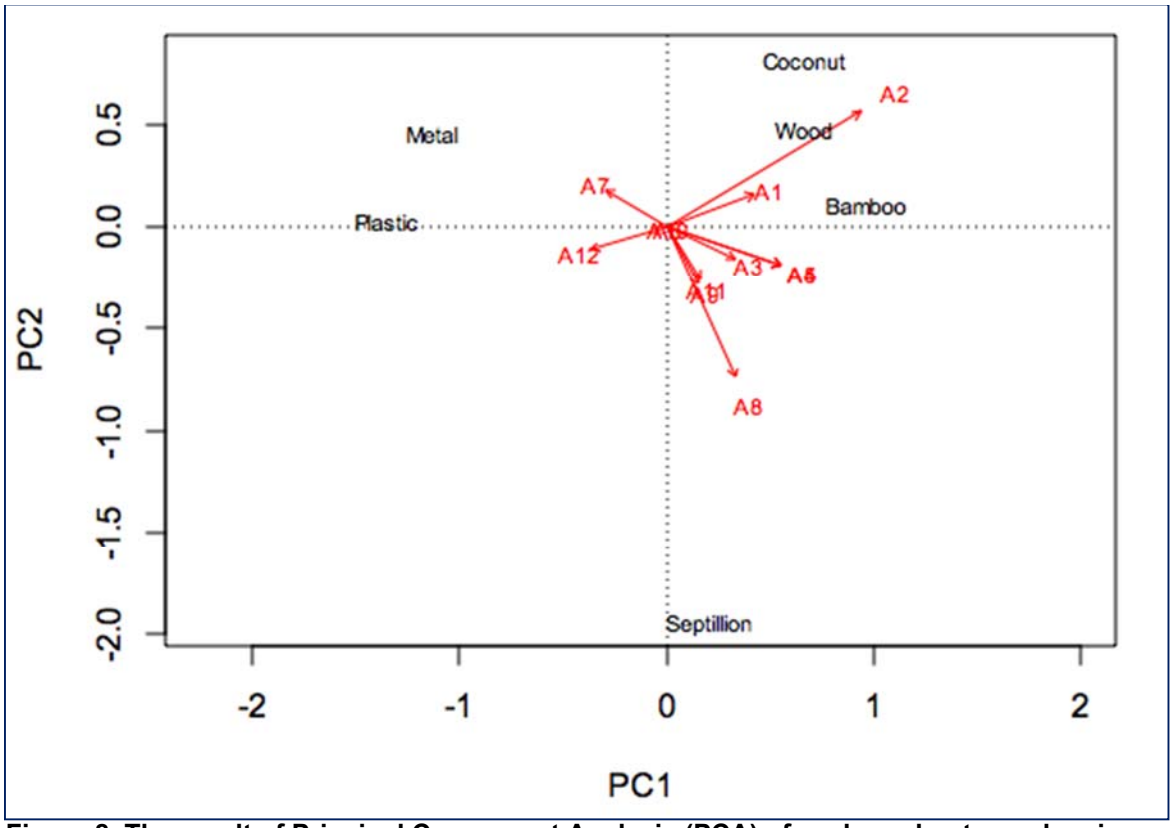

Figure 8. The result of Principal Component Analysis (PCA) of each marker toward various criteria used, pollution (A1), easy decomposed (A2), cost (A3), availability (A4), production (A5), setup (A6), robustness (A7), operational impact (A8), safe for user (A9), safe for catches (A10), accepted by users (A11), and easy for monitoring (A12).

The flexible Septillion barcode material enables it to adapt with the binder on the rope, which prevents the mesh becoming entangled. In addition, it also protects the fishers' hands from being injured during setting and hauling. However, the disadvantage of plastic material used in the Septillion tag is that it is not environmentally-friendly. If lost the tag becomes marine debris, which contravenes the principle objectives of the project that was designed to reduce the prevalence of harmful fishing litter in the marine environment. In addition, the QR code in the tag gradually lost readability with a scanner over time due to the exfoliation of the laminate layer as a result of the salt water and sunlight. Furthermore, the frequency and consistency of scanning by enumerators was inconsistent, meaning that ultimately the value in utilising this technology was questionable. These factors must be considered for future refinement of the Septillion FibreCode tag.

Figure 9. Tags tested during fishing gear marking experiment. Metal, bamboo and Septillion tags are shown here with cable tie attachments.

3.2. Pekalongan

The study on gear marking of gillnets in Central Java Province was conducted at Krapyak (fishing village) in Pekalongan district (Figure 10). Three gillnet fishers were involved in the experiment in this site. Each fisher operated one fleet of nets consisting of 30-40 pieces of gillnets. Each net piece is normally attached with two identifying markers including flags, floats and buoys both above and below the surface of the water. The marking is done alternately on the head rope and ground rope.

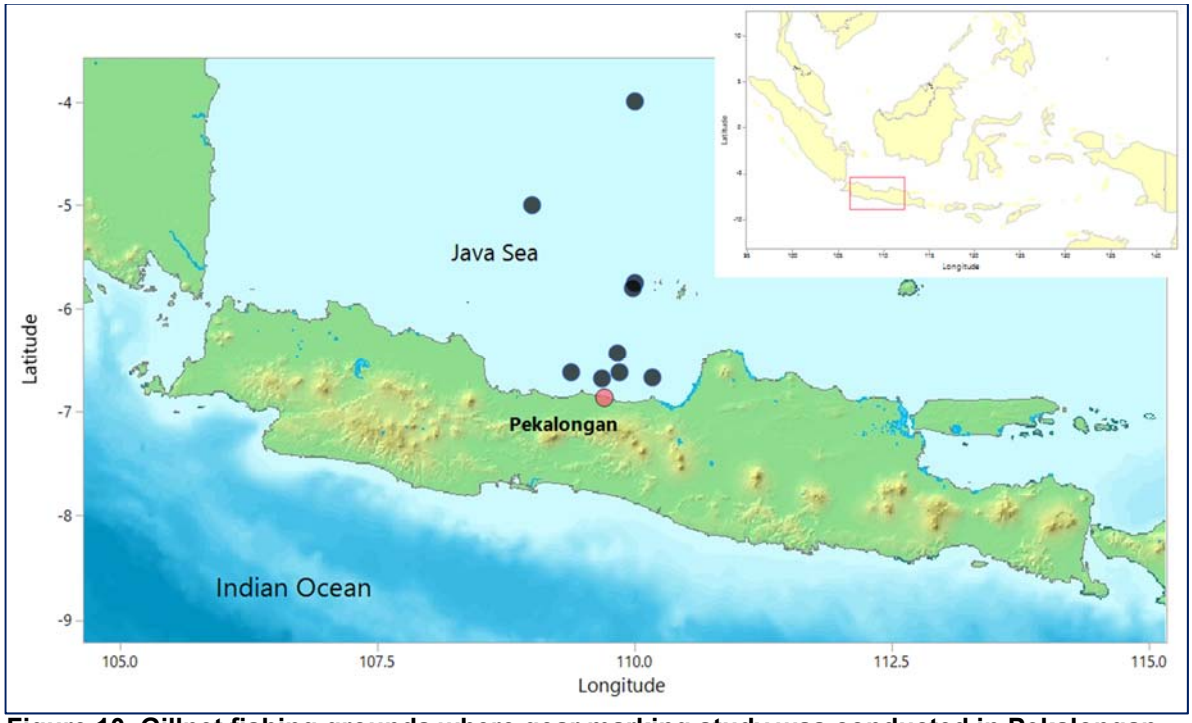

Figure 10. Gillnet fishing grounds where gear marking study was conducted in Pekalongan.

The fishers in Pekalongan currently use flags and flash lights for gear markers, so the concept of using tags to mark the gillnet directly for identification was new. The flag systems are only used to determine the existence of a net when operated and to facilitate easier location by the fishers, not to determine the net position when lost or provide ownership identification.

The field-testing in Pekalongan was undertaken using a similar approach to Sadeng, except the Septillion tags were not deployed due to a delay in delivery. In Pekalongan, metal, plastic, wood, bamboo and coconut shells were tested during the trial. Data were also collected by enumerators and overseen on three supervision visits. During the visits the team checked if the tags were still in place, inspected condition of tags, counted the number and percentage of tags lost and prepared findings based on interactions with the fishers. Data collected during the supervision trips are shown in Figure 11.

Fishers	Tags	Number of days																												
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
A	M	5													0																
	P	5													5																
	W	5													5																
	B	5													5																
	C	5													5																
	S																													
B	M	5						5												5										
	P	5						5												3										
	W	5						3												3										
	B	5						5												5										
	C	5						5												5										
	S																													
C	M	5								5																				
	P	5								5																				
	W	5								3																				
	B	5								5																				
	C	5								5																				
	S																													

Fishers	Tags	Number of days																												
		31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55				
A	M						0																		0					
	P						2																		0					
	W						5																		0					
	B						5																		0					
	C						1																		0					
	S																													
B	M															3														
	P															0														
	W															2														
	B															4														
	C															4														
	S																													
C	M		0																						0					
	P		2																						2					
	W		3																						1					
	B		5																						2					
	C		5																						5					
	S																													

Figure 11. Survey data from supervision visits. M - metal; P - plastic; W - wood; B - bamboo; C – coconut; and S - Septillion).

The tags were photographed in their original form and then during the survey where possible in order to confirm quality of tag, degradation rate and any other notable changes; examples are shown in Figure 12.

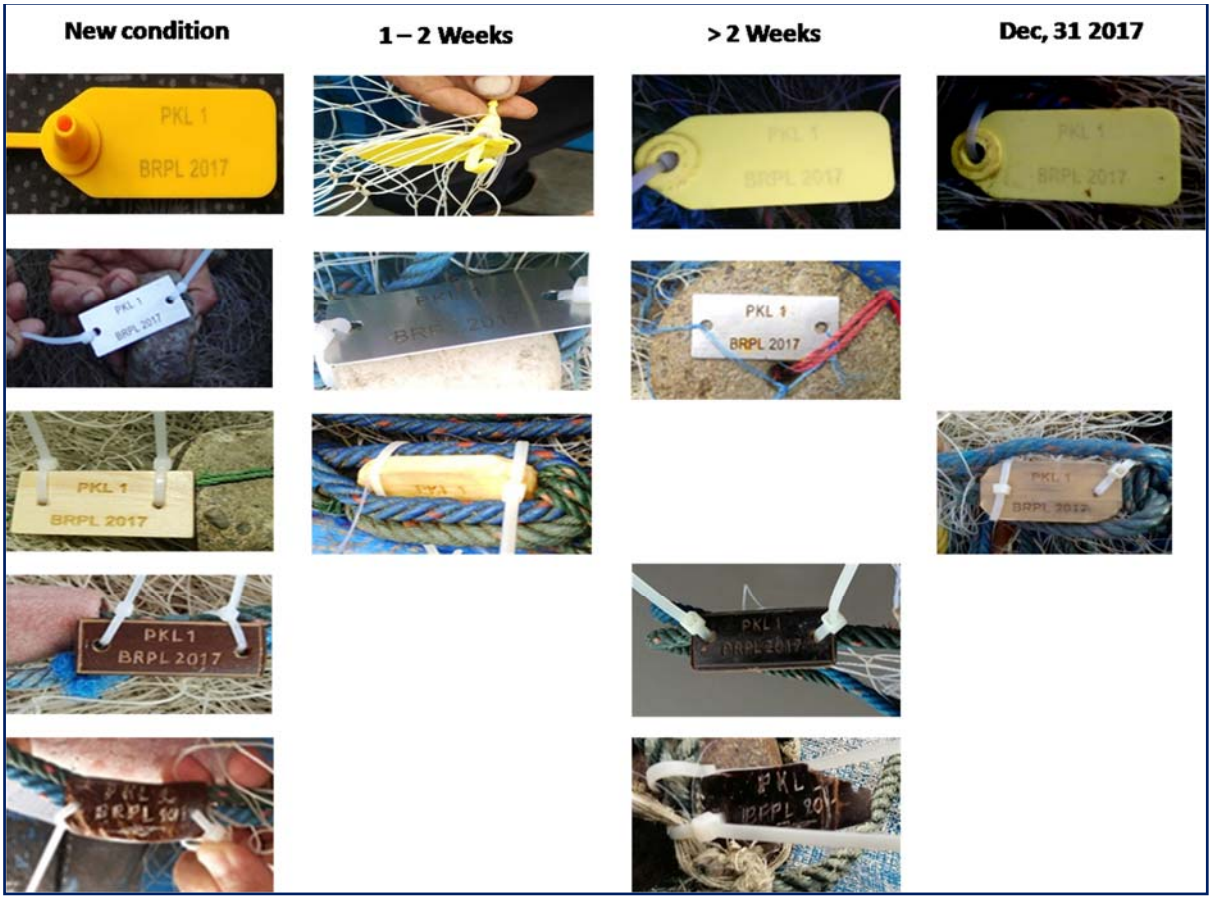

Figure 12. Tags photographed during the study in Pekalongan. From the top, the images show the plastic, metal, wood, bamboo and coconut tags.

In Pekalongan the metal and plastic tags were lost most frequently, but this was attributed to a potentially faulty application system as the tags were applied during operation. In this site, the markers were attached during the setting of nets using cable ties, but they were frequently lost or broken during fishing. The project team proposed in future trials a smaller C-clamp style attachment would be more resilient. During the observation, the team also noted that it was unclear whether markers were detached accidentally during operation or deliberately by fishers due to their negative impact on fishing operation.

The team concluded that a smaller marker made of durable material could work in this context. Prior to making recommendations for regulation however, a more thorough investigation into acceptance of gear marking and an application process that works during net setting and hauling, without disruption to fishing operations, would need to be explored.

4. Summary and conclusions

In general, small-scale fishers in the project sites in Indonesia were cooperative and supportive of the gear marking activities. However, there is a need for greater understanding of the benefits of gear marking and further work should be done on related issues, particularly the ability to retrieve the gear when lost. Based on interviews with lobster gillnet fishers in Sadeng, high numbers of gillnets are lost due to unfavourable weather conditions. It was estimated that up to 70% of nets are lost and yet less than 30% can be retrieved. These numbers were attributed to lobster gillnet fishers being less likely to spend effort retrieving the lost gear due to its low value, thus they tend to leave it at sea if lost after some attempts to recover with a drag. However, it is recognized there is a lack of baseline data on gear loss for lobster gillnet fisheries in Indonesia, particularly for small-scale gillnet fisheries.

Implementing gear marking within the context of a small-scale gillnet fishery, such as those that have been subject to this trial in Indonesia, is possible providing that a holistic implementation plan is in place encompassing capacity building and related support, data collection, fisher education and incentives. There is a recognized appetite for a multi-pronged approach to address ALDFG and IUU fishing through prevention, mitigation and cure.

There may be some challenges to applying certain types of technology in the context of both small-scale fisheries in general, and gillnet fisheries in particular, due to the cost of more technical marking options and the comparative low value of the gear itself. Marking at manufacturer level and adding value to end-of-life gear could be potential approaches to address these issues.

Availability of environmentally-neutral materials for tags and their attachments, and fisher safety when operating gear with physical tags were both key issues that arose during this project and further guidance on these aspects within the gear marking guidelines may be helpful. In this trial, plastic cable ties were used to attach the tags to the nets due to the accessibility of this type of attachment. Not only is this not environmentally neutral but they were also found not durable. This was identified as a significant challenge.

Amongst the project team, there were concerns around the lack of International Maritime Organisation (IMO) registration numbers for small-scale vessels in Indonesia, posing a monitoring and enforcement challenge for gear marking.

Gear marking must be implemented in the context of broader measures for managing fishing gear and managing fisheries in general. Without due consideration of the wider framework of measures, gear marking alone is unlikely to solve the significant ALDFG issues that are apparent in Indonesian small scale-scale and probably other similar fisheries, particularly in developing countries. In this trial for example, in inshore high risk gill net fisheries (e.g. lobster fisheries in rocky inshore habitat) gear were often lost or damaged n 1-3 days. In cases like this it is both the gear type and the environmental conditions that are contributing towards frequent gear loss. Consideration should therefore be given to prioritising other approaches to mitigate the risk of the lost gear on marine habitats e.g. using degradable materials for the fishing gear, developing safe retrieval methods and reporting of lost gear. Additional preventative measures should also be implemented and could include fisher education and awareness raising, capacity building in general, spatial management of fishing effort and a circular economy approach to managing end-of-life gear. Identifying incentives for fishers to participate in solution projects was an important learning in the project.

5. Recommendations

During the January 2018 project review workshop, the following recommendations and considerations for any further phases of the project were agreed upon by the project team, taking into account the key sections of the FAO Draft Guidelines.

Implementation of a gear marking system

- For successful implementation of gear marking there needs to be a clear implementation plan which takes into consideration the need for capacity building and education to build understanding and acceptance of the objectives for marking fishing gear and the process for enforcement.
- Consensus is required from fisheries stakeholders to develop and implement a successful gear marking system. Regulation alone will not be effective as consensus is necessary between different stakeholders within the fishery before it will be adopted.
- Marking methods must be appropriate to small-scale fishers and consider all elements of the criteria outlined during this trial (pollution risk, fisher safety, cost, ease of installation, lifespan/durability, ease of monitoring and availability of material).
- Some marking methods may score highly against most of the criteria but low against something else which is critical. For example, in this trial plastic tags were found to be a successful way of marking fishing gear but they present environmental challenges that make them inappropriate as a choice of tag. Metal tags were not as damaging to the environment but were found to be a hazard to fishers when setting or hauling the nets.
- It is indicated from the field trial and from the workshop that bamboo and wooden tags were preferable for Pekalongan fishers and Septillion FibreCode technology tags were favourable for Sadeng fishers. However, the plastic material used in the Septillion tags was suggested to be replaced with a biodegradable material on which the same code could be printed.
- Further consideration should be given to the methods that are used to attach tags to fishing gear. During the trial, the fishers found plastic cable ties to be the most readily available form of attachment device. However, such cable ties did not always keep the tag in place and potentially posed a pollutant risk to the marine environment if lost. While other methods of marking, including colour coding and the use of an embossing tool to mark floats on the lines, were considered, it was not possible to arrange these methods for the trial due to material availability and logistical challenges. The durability of these favourable non-plastic materials remains an issue. These aspects should be considered in future trials and when further developing FAO's Draft Guidelines.
- Colour coding of nets during manufacturing process to denote fishing area would be viable if fisheries-area level identification is desirable, however this would need to be implemented via manufacturers and was not possible for this trial.
- It should be noted that requirements for tags and other markers to correspond with licences and International Maritime Organisation (IMO) numbers would not be applicable to all small-scale fisheries;
- Clear guidance is necessary to inform whether the tags should be on the head rope or lead line due to the fact that the rope components are normally retained and re-used;
- The timing of installation of tags as markers is also critical. In one project site gear was marked prior to deployment, whereas in the other gear was marked during operation which was not effective.

Control and monitoring

- Rigid legislative control and enforcement may not be appropriate in small-scale fisheries. The benefits of gear marking need to be communicated so that fishers are incentivised and would voluntarily apply gear marking. Regulation could lead to reduced income for fishers and this must be considered.
- Gear marking could be considered an eco-friendly fishing practice that in the future could create market-driven incentives for responsible gear management. Further investigation of this approach is recommended.
- Co-management with fishing communities (e.g. through cooperatives / fisher groups) would help effectively implement gear marking systems.

Reporting of lost gear

- Lost fishing gear is currently not reported in Indonesia small-scale fisheries. Fishers search for lost gear themselves if the gear becomes lost, and there is no centralised system for reporting and retrieving lost gear.
- It is recommended that reporting systems could be implemented that would enable data collection and increase the potential for retrieval of lost gear. Such a reporting system would need to incorporate incentives and benefits for reporting lost gear and detail clear lines of responsibility so that fishers know who to report to and what information they need to report.

Location, recovery and retrieval

- It is a recognised concern that in some areas the fishing conditions present high-risk to fishing operations (for example depth, weather conditions), making retrieval operations unlikely. Small-scale fishers in the pilot sites were already using flash lights and flags to locate fishing gear. The small vessels in most cases do not use GPS and their main or only communications device on board is a mobile phone. The accessibility that most fishers have to a mobile phone should be considered when developing best practices for locating and recovering lost gear.
- Fishers often use a drag to recover lost gear which can be effective but may be damaging to sensitive marine habitats, e.g. coral. It may be necessary to carry out cost-benefit analysis to determine whether removal of gear may be more harmful than it remaining in the environment in some cases. In the pilot sites the preferred drag type was a device used for octopus fishing that is manually hauled using a line. It is recommended that all vessels carry suitable equipment for retrieving gear;
- The pilot study highlighted the high frequency of gear loss in some areas of the project sites due to high-risk environmental conditions. There was a stated willingness for fishers to undertake retrieval operations in ‘hotspot’ areas for gear loss when it is safe to do so, or to work with divers to survey and remove lost gear, if the operations are supported either by incentives or subsidies. However, greater technical capacity for retrieval of lost gear at depth is required.

Further research and development

- The most favoured gear marking method was the Septillion FibreCode tag due to the possibility to collect more detailed information within the tag around ownership, location and lifespan of

gear, which has clear benefits for traceability, but further research is needed on how codes may be applied on non-plastic tags.

- Shape and material was also a key factor in fishers' feedback from the trial, with rigid and strong tags (e.g those made from metal) becoming an issue of fisher's safety when the nets are manually hauled, and likely also to cause issues for mechanical hauling. These aspects must therefore be considered when developing new gear marking methods.
- This trial predominantly addressed the practical application of tags to fishing gear and evaluated their effectiveness; however it was acknowledged that whilst gear marking can be an effective tool in addressing ALDFG and IUU, it needs to be incorporated into a more holistic approach aimed at increasing understanding of responsible fishing gear management, for example through guidelines and associated training as an essential preventative tool, and to incentivise responsible behaviour through subsidies or programmes to generate value from waste fishing nets.
- A followup phase of this project is highly recommended which, in addition to addressing the technical aspects of gear marking, e.g., testing non-plastic alternatives and other technologies for marking, should incorporate increased emphasis on retrieval, preventing gear loss in high-risk conditions, education, and some scoping to explore practical challenges of a circular economy model in Java for recycling end-of-life and recovered fishing gear.
- Lack of robust data on gear loss and dynamics of the loss was a noted concern within the project. Existing data for the baseline in the project was compiled from focus group surveys and interviews with fishers. However, there is a need to establish more robust quantification of gear loss and location, via data collection, reporting systems and 'hotspot' mapping to focus efforts for mitigation and recovery.
- Support and collaboration with multi-stakeholder platforms with expertise in developing ALDFG solutions such as the Global Ghost Gear Initiative has been viewed as beneficial by the local stakeholders and could be considered as a route to further research and development in these project sites as well as a way of applying learnings from this project to other locations.

Awareness raising and capacity building

- There is a clear need for building awareness within small-scale fisheries about best practice for broader fishing gear management and about the benefits of applying these measures;
- Capacity building at local fisheries management level is essential for increased community engagement and to address the logistical and infrastructural challenges identified around net collection, storage and recycling;
- Case studies providing practical examples from other regions may be used to increase understanding and positive engagement with best practices. Increased capacity to share learnings internationally would be a clear benefit to facilitate the replication of successful solutions in new regions.

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Appendices

Appendix 1

Baseline study of ALDFG (abandoned, lost or otherwise discarded fishing gear), on gillnet fisheries: Case Study in Pekalongan and Sadeng (Jogjakarta)
Field Report 1

BRPL (and WAP)

BRPL/WAP-ALDFG-012017

ACTIVITIES: 1st trip survey,
LOCATION: Central Java, Pekalongan (Jambean, Wonokerto, Krapyak).
PARTICIPANT:
1. Erfind Nurdin
2. Hufiadi
3. Tri Wahyu Budiarti
4. Baihaqi
5. Agus Salim

TIME: 15 – 21 July 2017

INTRODUCTION

The issue of abandoned, lost or otherwise discarded fishing gear (ALDFG) has been a concern for FAO and its Members for many decades. It has been noted that the elaboration of a standard for the marking of fishing gear would be of benefit to coastal States in addressing problems associated with ALFDG. Marking of fishing gear can also be an important mechanism for identifying illegal fishing gears and may assist in meeting various obligations under relevant international instruments whether they are a binding agreement or voluntary guidelines.

The aim of this study was to identify the conditions of gear marking on gillnet fishery and monitoring the fishing gear provided by directorate general of capture fishery DGCF-MMF. Regarding loss rates, marking perception, number and type of gillnets, marking issues, current marking practices, cost, loss causes and dynamics, gear components and equipment, depth, hauling techniques, link to IUU in pilot site, incentives for marking

RESULT

Institutions visitation
1. Fisheries and animal husbandry department Kab. Pekalongan
2. Port authority (PPN Pekalongan)
3. Fishery community (kelompok nelayan)

Number and type of gillnets
1. Gillnet PA monofilament – bottom gillnet (provided by DGCF-MMF, 130 units)
2. Gillnet PA monofilament (8-10 ply) – surface and bottom gillnet
3. Gillnet PA multifilament – bottom gillnet

Catch
1. Gillnet PA monofilament – bottom gillnet:
   Snapper (kakap), barracuda (alu-alu), barred queenfish (talang-talang), threadfins (kuro/senangin), catfish (sembilang), indian halibut (sebelah), silfer pomfret (bawal putih), japanese meagre (tiga waja), pari (ray)
2. Gillnet PA monofilament (8-10 ply), surface dan bottom gillnet
   (Surfece: Mackerel (tenggiri), frigate mackerel (tongkol), threadfins (kuro/senangin),, needle fish (cendro), indian mackerel (banyar), opah (semar), scad (selar).
   Bottom: Snapper (kakap), barracuda (alu-alu), barred queenfish (talang-talang), threadfins (kuro/senangin), catfish (sembilang), silfer pomfret (bawal putih).

3. Gillnet PA multifilament – bottom gillnet
   Barred queenfish (talang-talang), needle fish (cendro), threadfins (kuro/senangin), catfish (sembilang).

Current marking practices

1. Flag
2. Flash light
3. Colouring the twine (provided by DGCF-MMF, 130 units)

Fishing ground

Substrate type:

1. Mud
2. Sandy mud

Depth:

1. Bottom gillnet monofilament: 10 – 15 m
2. Surface and bottom monofilament multiply: 30 – 50 m
3. Bottom gillnet multifilament: 10 – 15 m

Fishing techniques, (setting, hauling, soaking – fishing method)

Setting:

1. Bottom gillnet monofilament: 0,5 hour
2. Surface and bottom monofilament multiply: 1 hour
3. Bottom gillnet multifilament: 0,5 hour

Hauling:

1. Bottom gillnet monofilament: 2 – 4 hours
2. Surface and bottom monofilament multiply: 2 – 7 hours
3. Bottom gillnet multifilament: 2 – 4 hours

Soaking:

1. Bottom gillnet monofilament: 2 – 4 hours
2. Surface and bottom monofilament multiply: 3 – 11 hours
3. Bottom gillnet multifilament: 2 – 4 hours

Capture equipment

1. Line hauler 16 HP,
2. Navigation: GPS (Furuno dan Garmin)
3. Communication tool: Cellular phone

Survey questions:

If you loss nets on average how often does this occur?

Rarely

If you loss nets what do you do?

Searched for one day

Loss causes and dynamics

1. Gear conflict
2. Snagged on coral

What do you do with your damaged nets?

If the fishing gear is damaged during operation, the fishing gear is taken home for repair or used as a replacement material

Link to IUU in pilot site

Illegal: The length of GN is operated over 2.5km, mesh size (see FAO and Indonesian fishing gear regulation)
Legal: Size of gillnet is less than 2.5km
Measurement of mesh size:

1. Bottom gillnet monofilament: 4 – 4½ inch
2. Surface and bottom monofilament multiply: 3½ – 4 inch
3. Bottom gillnet multifilament: 2½ inch

Other:
Turtles and dolphins dead or alive are released

Incentives for marking and retrieval

Current practice there are no incentive for marking

Gear marking

During this time the marking of fishing gear was done by fishermen for the safety of the gear (lost, hit by other vessels, stolen by other fishermen) and made it easier to find gear if lost. Marking of fishing gear using flags and lamps

Retrieval techniques

1. Looking for flags or lights
2. Using drag to retrieve gear

Identification of cooperatives who will receive gear in 2017 from DGCF system and which manufacturers, which fishers and associations received gear in 2016.

Attached data (Penerima Bantuan FGear.xlsx)

Identification of potential partners for pilot project - fishers, associations, NGOs, gear manufacturers, seafood industry, fishery services, port authorities, province and district fisheries authorities.

1. Bapak Darjo (Fishery community) – Krapyak (Kota Pekalongan)
2. Fishing Port authority (PPN Pekalongan)
3. Fisheries and animal husbandry department Kab. Pekalongan

Design of monitoring survey for fishers using marking techniques to collect baseline data.

Data collection procedure:

1. Official letter request for production and fishing gears data;
2. Companion request to Head of Pekalongan Fishing Port authority (PPN Pekalongan)
3. Direct interview with fishers and fishery community.

CLOSING

The fishers in Pekalongan used Flag and flash light for gear marker. Markers are only used to determine the existence of a net when operated, not to determine the net position when lost

APENDIX
Gear components and equipment

Gillnet monofilament (DGCF - MMF)

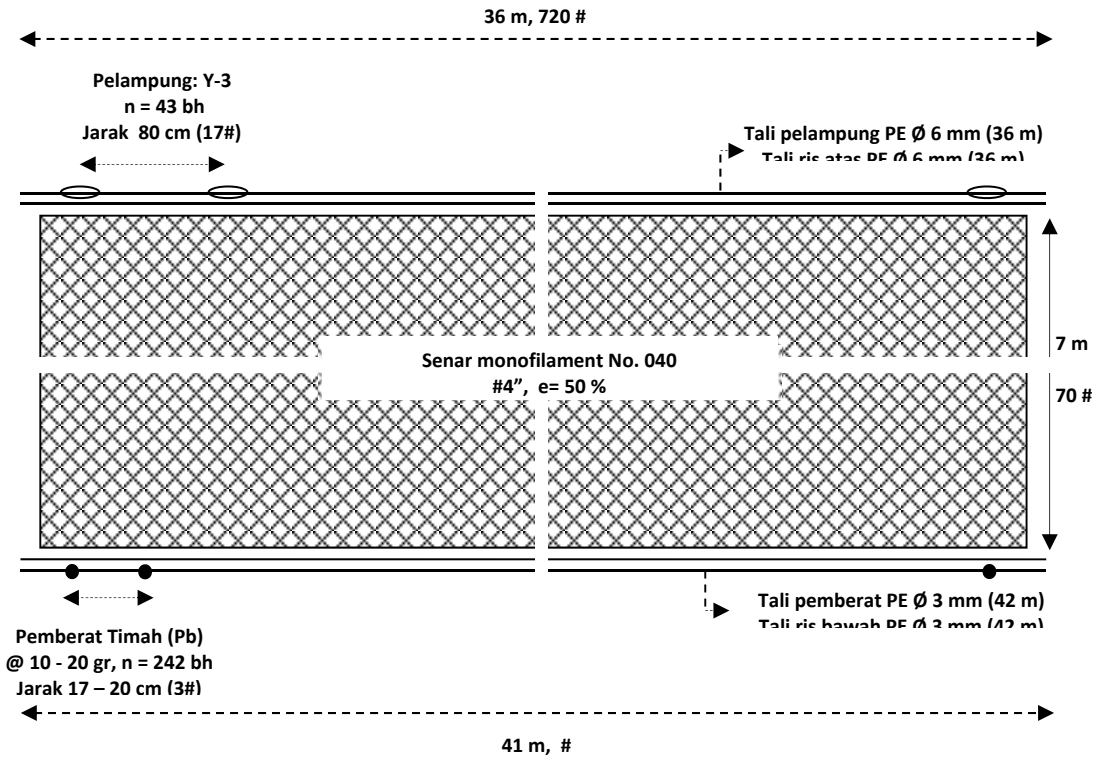


Figure 1. One piece of gillnet monofilament from DGCF-MMF (15 pieces for 1 unit fishing gear)

Gillnet monofilament

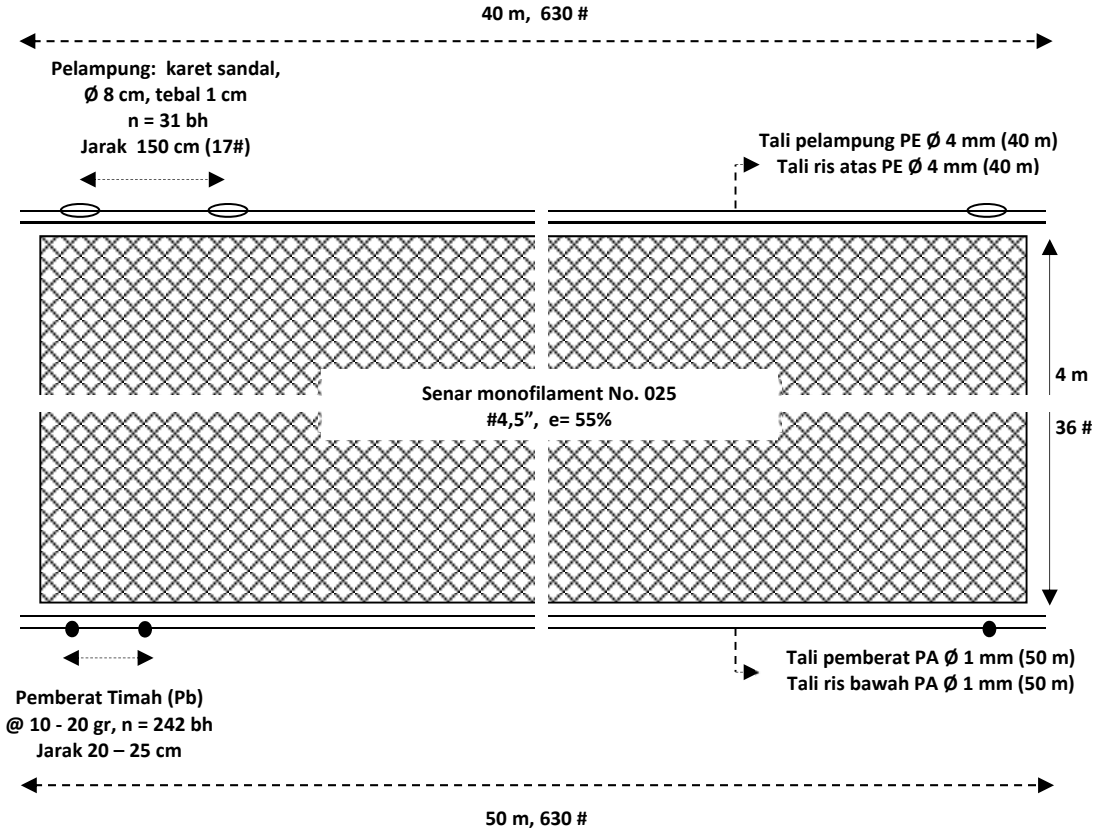


Figure 2. Gillnet monofilament (40 pieces for 1 unit fishing gear)

Note:
The gear mark using flag and flash light
flag lines: PE Ø 6 mm, length 50 m

Bottom gillnet multifilament

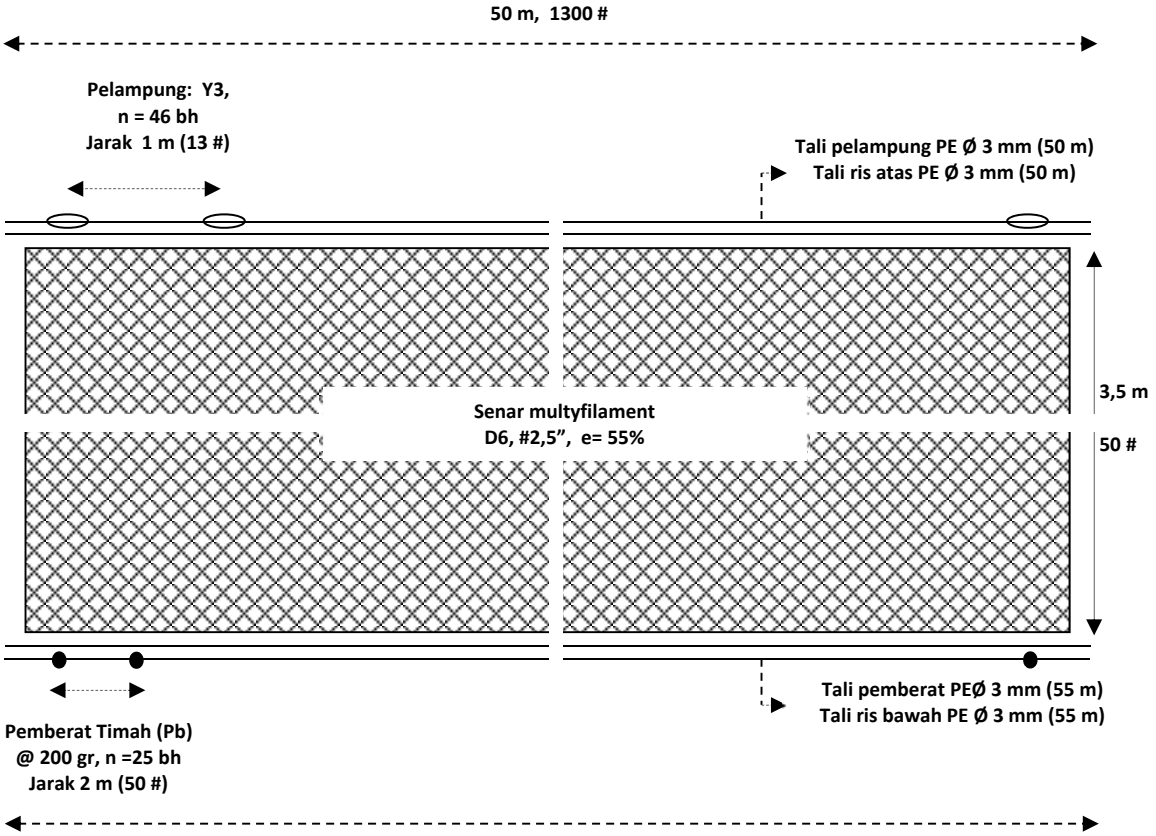


Figure 3. Gillnet multifilament (20 pieces for 1 unit fishing gear)

Note:
The gear mark using flag and flash light.
flag lines: PE Ø 6 mm, 30-50 m length.

Gillnet monofilament multiply

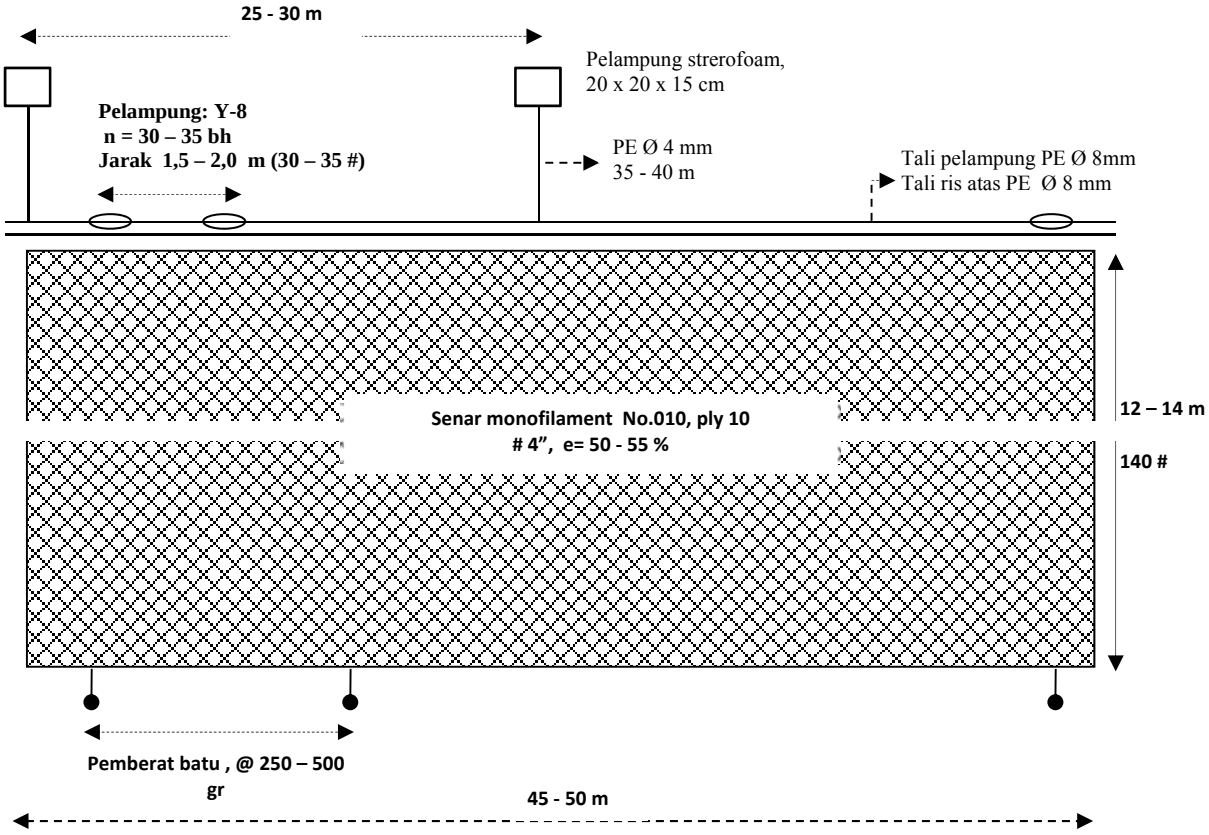


Figure 4. Gillnet monofilament multiply (30-40 pieces for 1 unit fishing gear)

Note:
The gear mark using flag and flash light.
flag lines: PE Ø 6 mm, 30-50 m length

Appendix 2

Baseline study of ALDFG (abandoned, lost or otherwise discarded fishing gear), on gillnet fisheries: Case Study in Pekalongan and Sadeng (Jogjakarta) Field Report 2

BRPL (and WAP)

BRPL/WAP-ALDFG-012017

ACTIVITIES: 1st trip survey,
LOCATION: Central Java, Jogjakarta (Sadeng).
PARTICIPANT:
1. Mahiswara
2. Agustinus Anung W
3. Andria A Utama
4. Hufiadi
5. Baihaqi

TIME: 20 - 24 August 2017

INTRODUCTION

The issue of abandoned, lost or otherwise discarded fishing gear (ALDFG) has been a concern for FAO and its Members for many decades. It has been noted that the elaboration of a standard for the marking of fishing gear would be of benefit to coastal States in addressing problems associated with ALFDG. Marking of fishing gear can also be an important mechanism for identifying illegal fishing gears and may assist in meeting various obligations under relevant international instruments whether they are a binding agreement or voluntary guidelines.

The aim of this study was to identify the conditions of gear marking on gillnet fishery and monitoring the fishing gear provided by directorate general of capture fishery DGCF-MMF. Regarding loss rates, marking perception, number and type of gillnets, marking issues, current marking practices, cost, loss causes and dynamics, gear components and equipment, depth, hauling techniques, link to IUU in pilot site, incentives for marking

RESULT

Institutions visitation

1. Fisheries office at Provincial level - Daerah Istimewa Yogyakarta Province
2. Fishing port authority (Sadeng Coastal Fishing Port-Gunung Kidul)

Number and type of gillnets

Based on material types
1. Multifilament surface gillnet – mesh size. 4½ - 5 inch
2. monofilament surface gillnet – mesh size 2¼ - 4 inch
3. Monofilament bottom gillnet – mesh size 3 – 4½ inch
4. Monofilament bottom gillnet for lobster – mesh size 4 inch

Current marking practices

1. Flag
2. Flash light

Gear components and equipment

Gillnet monofilament (DGCF-MMAF)

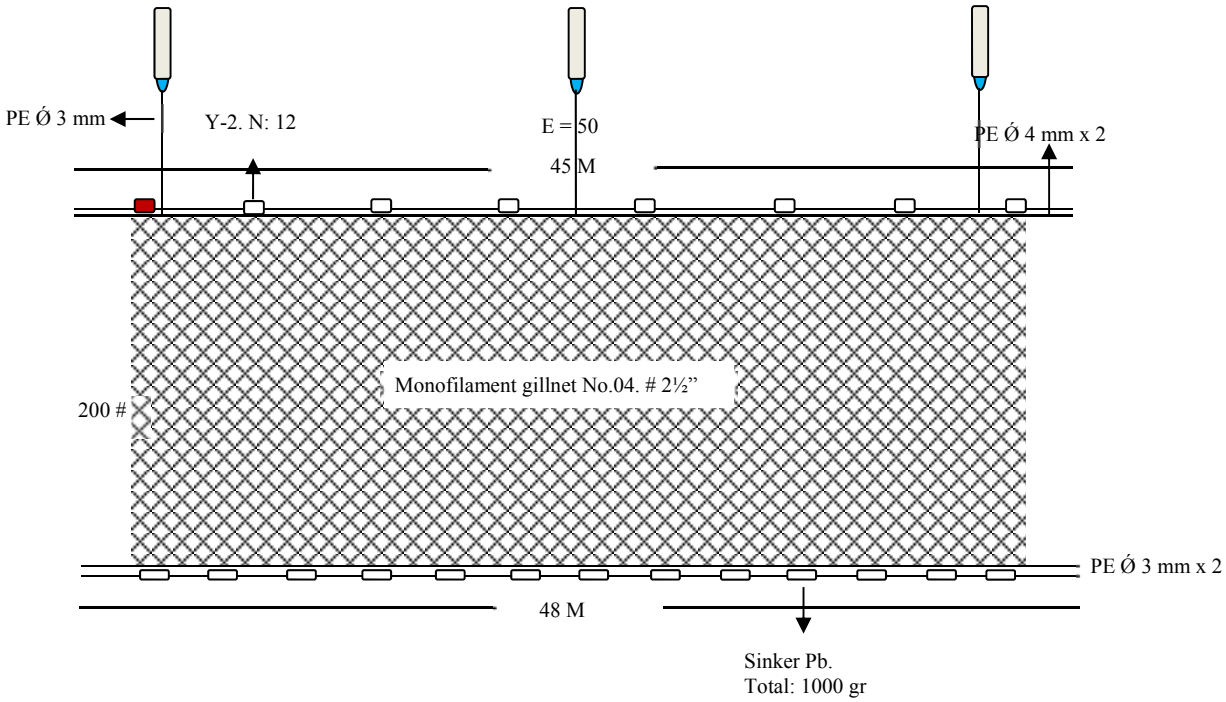


Figure 1. Multifilament surface gillnet in Sadeng (1 unit consists of 12 pieces) (Doc. Adjusted).

Information:
Flash light marking is deployed at the end of net (two sides per gillnet unit. Rope PE Ø 12 mm, length 12 m.

Figure 2. Monofilament surface gillnet for large pelagic in Sadeng (1 piece) (1 unit consists of 15 pieces) (Doc. Adjusted).

Information: Flag and flash light marking are deployed at the end of net (two sides per gillnet unit. PE rope Ø 6 mm, length 12 m.

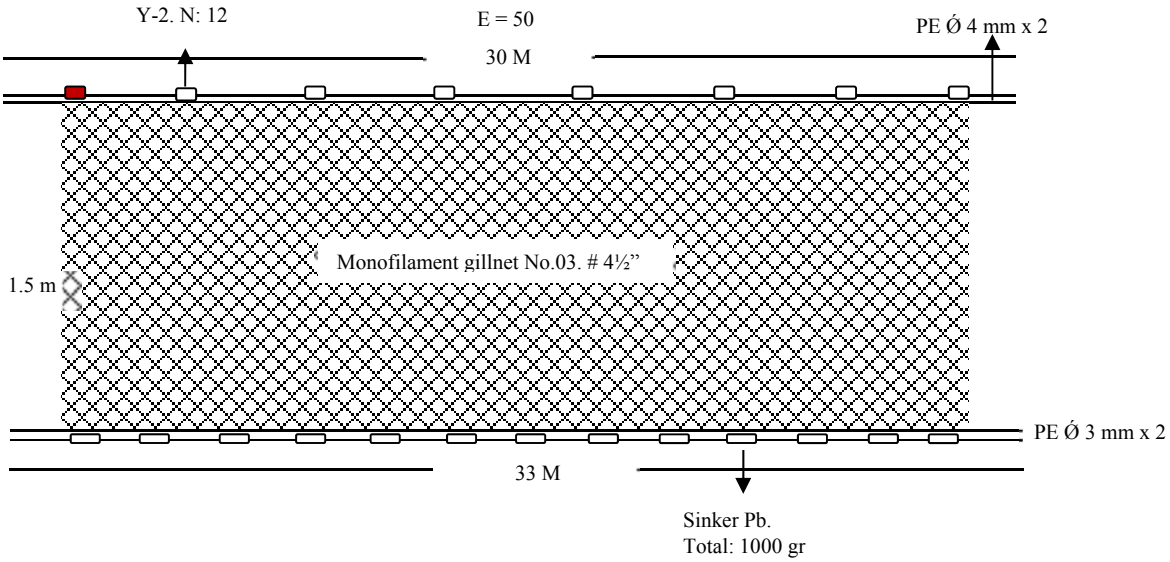
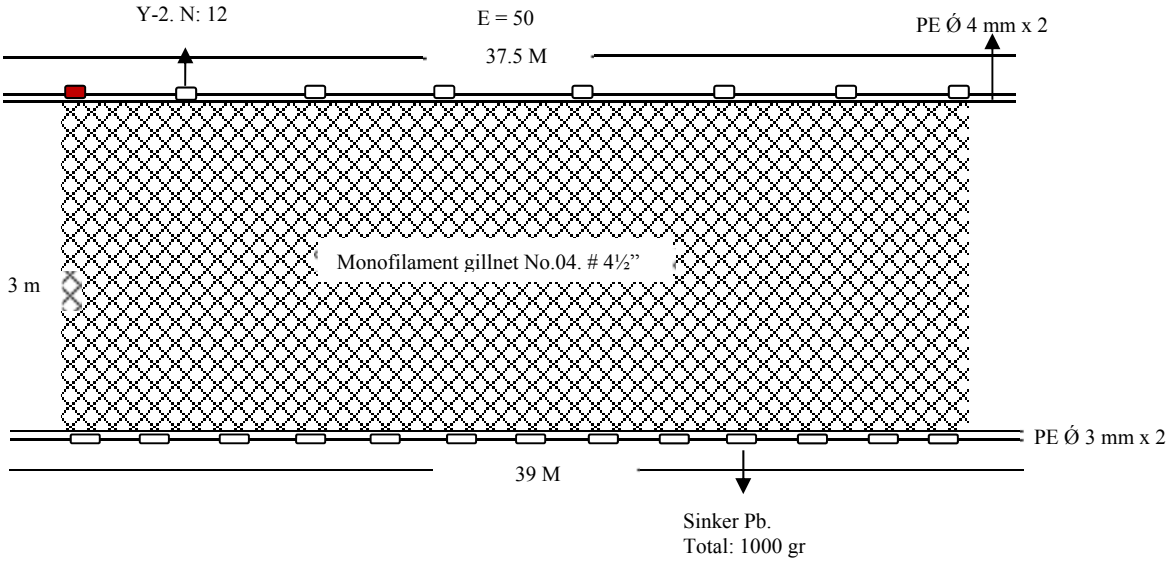


Figure 3.

Monofilament bottom gillnet (1 piece) (1 unit consists of 35 pieces) (Doc. Adjusted).

Information: Flag marking is deployed at the end of net (two sides per gillnet unit. PE rope Ø 6 mm, length 200 m.

Figure 4. Monofilament bottom Gillnet for lobster (1 piece) (1 unit consists of 15) (Doc. Adjusted)



Information:
Float marking is deployed at the end of net (two sides per gillnet unit). PE rope Ø 6 mm, length 10 m.

Catch composition:

1. Multifilament surface gillnet (mesh size 4½ - 5 inch) – target species are the frigate and bullet tunas, tuna, skipjack, and dolphin fish.
2. Monofilament surface gillnet (mesh size 2¼ - 4 inch) – target species are the frigate and bullet tunas, tuna, skipjack, and dolphin fish.
3. Monofilament bottom gillnet (mesh size 3 - 4½ inch) – target species are flounder, snapper, sea catfish, emperor fish.
4. Monofilament bottom gillnet for lobster (mesh size 4 inch)– target species is lobster

Fishing ground:

Depth of fishing ground

1. Multifilament surface gillnet – Disekitar Rumpon (>1000 m)
2. Monofilament Surface gillnet
3. Monofilament bottom gillnet – 200 m
4. Monofilament bottom gillnet for lobster – around reefs

Fishing techniques (setting, hauling, soaking – fishing method)

Setting:

1. Multifilament surface gillnet: 30 minutes
2. Monofilament surface gillnet: 20 minutes
3. Monofilament bottom gillnet: 30 minutes
4. Monofilament bottom gillnet for lobster: 30 minutes

Hauling:

1. Multifilament surface gillnet: 2 hours
2. Monofilament surface gillnet: 3 – 5 hours
3. Monofilament bottom gillnet: 5 – 6 hours
4. Monofilament bottom gillnet for lobster: 3 hours

Soaking:

1. Multifilament surface gillnet: 3 – 5 hours
2. Monofilament surface gillnet: 1 hour
3. Monofilament bottom gillnet 0,5 hour
4. Monofilament bottom gillnet for lobster: 11 – 12 h

Alat bantu penangkapan:

Fish Aggregating Device (FAD)
Light
Navigation equipment: GPS (furuno and garmin)
Communication equipment: Celuler phone

If you loss nets on average how often does this occur?

Frequency of gear loss: rarely

If you loss nets what do you do?

Searching the loss gears for approximately 1 day

Loss causes and dynamics

1. Weather condition (bottom gillnet, lobster gillnet)
2. Sinking because overweight of catches (PA monofilament and multifilament gillnet)
3. Entangled on coral reefs (bottom gillnet, lobster gillnet)

What do you do with your damaged nets?

Fishers are bringing back home damaged nets during fishing operation for repair or just for utilizing head rope.

Link to IUU in pilot site,
Illegal criteria: length dimension of gillnet >2,5 km, mesh size larger than national and international regulation.

Length dimension of gillnet <2,5 km (legal size)
Ukuran mesh size:

1. Multifilament surface gillnet – mesh size 4½ - 5 inch
2. Monofilament surface gillnet – mesh size 2¼ - 4 inch
3. Monofilament bottom gillnet – mesh size 3 – 4 inch
4. Monofilament bottom gillnet for lobster – mesh size 4 inch – lobster

Incentives for marking and retrieval
There are no incentives for marking on current practice.

Gear marking practice
Currently fishers are marking their fishing gear use flag, buoy, and flashlight for gear safety (avoid loss, crash by other vessels) and make the retrieving process easier.

Retrieval techniques

1. Searching for flag and light mark
2. Sinking nets will appear on surface in 5 days after entangled fish are decomposed thus possible to find the loss nets. However, there is little chance for the owner to get back the loss nets because no specific identity found on the nets.

Identification of cooperatives who will receive gear in 2017 from DGCF system and which manufacturers, which fishers and associations received gear in 2016.
Sadeng fishers will not receive any grants (fishing vessels or fishing gears).

Identification of potential partners for pilot project - fishers, associations, NGOs, gear manufacturers, seafood industry, fishery services, port authorities, province and district fisheries authorities.

1. Pak Sarpan, Head of Sadeng Fishery Community,
2. Pak Mustakim, Fisher (infomation: FADs position)
3. Pak Sutriono (Independent Business Creation Mina Rahayu)
2. Coastal Fishing Port Sadeng, Gunungkidul
3. Fisheries office of Daerah Istimewa Yogyakarta Province

Design of monitoring survey for fishers using marking techniques to collect baseline data.
Data collection procedure:

1. Focus Group Discussion;
2. Official letter request for production and fishing gears data;
3. Companion request with Head of Sadeng coastal fishing port;
4. Direct interview with fishers and fishery community.

CLOSING

The fishers in Sadeng used Flag and flash light for gear marker. Markers are only used to determine the existence of a net when operated, not to determine the net position when lost

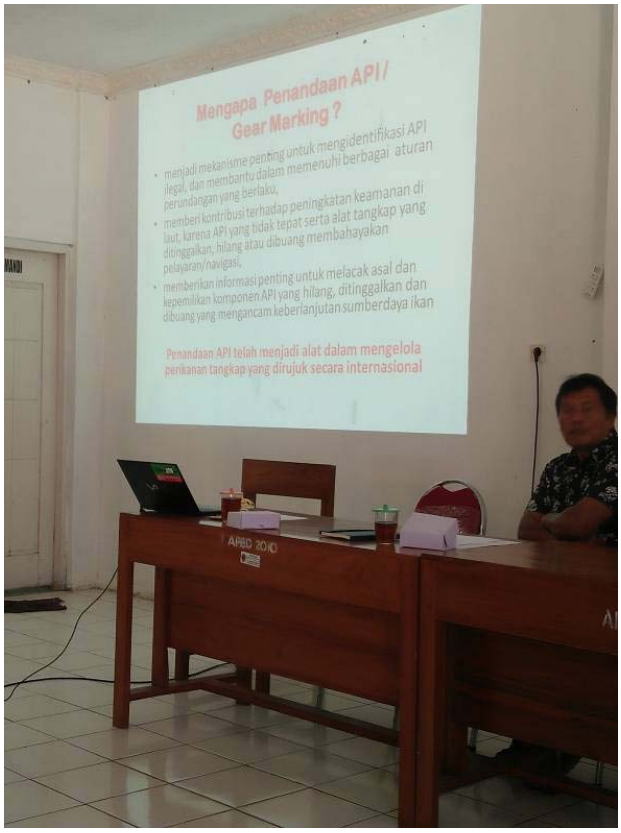
APPENDICES:

Activity documentation

Flag and buoy marking

Fishing fleets

Gear measurement and interview



Focus Group Discussion

Appendix 3

Baseline study of ALDFG (abandoned, lost or otherwise discarded fishing gear), on gillnet fisheries: Case Study in Pekalongan and Sadeng (Jogjakarta)
Field Report 3

BRPL (and WAP)

BRPL/WAP-ALDFG-012017

ACTIVITIES: 2nd trip survey,
LOCATION: Central Java, Pekalongan (Krapyak).
PARTICIPANT:
1. Erfind Nurdin
2. Hufiadi
3. Tri Wahyu Budiarti
4. Baihaqi

TIME: 6 – 12 November 2017

INTRODUCTION

The issue of abandoned, lost or otherwise discarded fishing gear (ALDFG) has been a concern for FAO and its Members for many decades. It has been noted that the elaboration of a standard for the marking of fishing gear would be of benefit to coastal States in addressing problems associated with ALFDG. Marking of fishing gear can also be an important mechanism for identifying illegal fishing gears and may assist in meeting various obligations under relevant international instruments whether they are a binding agreement or voluntary guidelines.
The aim of this study was to Set up enumerator and installation of marker tests on fishing nets

RESULT

Institutions visitation
1. Port authority (PPN Pekalongan)
2. Kelompok nelayan

Potential partners for pilot project - fishers
1. Muji (Owner and fisher)
2. M Riyanto (Capt.)
3. Achmad Bahrudin (Capt.)

Material marker

1. Metal
2. Plastic
3. Wood
4. Bamboo
5. Coconut shell

Scoring criteria

No	CRITERIA	Score			
		1	2	3	4
1	Pollution effect	Very high	High	Middle	Low
2	Easy to unravel	Very difficult	Difficult	Middle	Easy
3	Marker Cost	Expensive	Cheap	Very cheap	
4	Availability of goods	Available in certain places	Order	Limited	Plenty
5	Manufacture	Difficult	Middle	Easy	
6	Practical instalation	Very long	Long	Fast	Very fast
7	Marker endurance	fragile	Strong	Very strong	
8	Impact for net operational (disturb / annoying)	Very disturb	Disturb	Rather	Not
9	Safe for users	Low	Middle	High	Very high
10	Safe for fish catch	Not safe	Safe		
11	Accepted by fisher	Not accept	Accept		
12	Easy to monitor	Not visible	Not clear	Clear	Very clear

Analysis result

The result shows that the marker is more accepted by fishermen in Pekalongnan based on the result of multi criteria analysis are: bamboo, wood, coconut shell, plastic and metal.

Material	V(X)1	V(X)2	V(X)3	V(X)4	V(X)5	V(X)6	V(X)7	V(X)8	V(X)9	V(X)10	V(X)11	V(X)12	V(A)	Rank
Metal	0.00000	0.00000	0.00000	0.50000	0.00000	0.66667	1.00000	1.00000	0.00000	0.00000	0.00000	0.00000	3.16667	5
Plastic	0.16667	0.00000	0.50000	0.25000	0.20000	0.66667	0.50000	0.00000	1.00000	0.00000	0.00000	1.00000	4.28333	4
Wood	0.66667	0.83333	0.50000	0.25000	0.80000	1.00000	0.00000	1.00000	1.00000	0.00000	0.00000	0.33333	6.38333	2
Bamboo	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	0.00000	1.00000	1.00000	0.00000	0.00000	0.00000	8.00000	1
Coconut shell	0.66667	0.83333	1.00000	0.00000	0.80000	0.00000	0.25000	1.00000	1.00000	0.00000	0.00000	0.33333	5.88333	3

Enumerator record

Daily

MARKER	21-Nov-17											29-Nov-17										
	Metal		Plastic		Wood		Bamboo		Coconut shell		Other information	Metal		Plastic		Wood		Bamboo		Coconut shell		Other information
	A	B	A	B	A	B	A	B	A	B		A	B	A	B	A	B	A	B	A	B	
Lost	V	V	V	V			V	V	V	V												
Demaged (rusak)																						
Ties broken (Tali putus)														V	V							
Broken (patah)																						
Crooked (bengkok)																						
Others																						
LETTERS CONDITION AFTER USED																						
Letters still good (Tulisan Tidak Berubah)					V	V						V	V	V	V	V	V	V	V	V	V	
Letters missing (Tidak Terbaca)																						
Tulisan Tergerus Sebagian (masih terbaca)																						
MARKER INFLUENCE																						
Demaged the nets																						
Disturb the operatiopnal																						
Affect the quality of the fish																						
Affect the catch production												V	V	V	V	V	V	V	V	V	v	
No problem					V	V																
Other information																						
Noted: A (Above) ; B (Below)																						

Weekly

MARKER	14-Nov-17											16-Nov-17										26-Nov-17									
	Metal		Plastic		Wood		Bamboo		Coconut shell		Other information	Metal		Plastic		Wood		Bamboo		Coconut shell		Other information	Metal		Plastic		Wood		Bamboo		Coconut shell		Other information
	A	B	A	B	A	B	A	B	A	B		A	B	A	B	A	B	A	B	A	B		A	B	A	B	A	B	A	B	A	B	
Lost					V	V										V	V								V	V							
Demaged (rusak)																																	
Ties broken (Tali putus)																																	
Broken (patah)																																	
Crooked (bengkok)																																	
Others																																	
LETTERS CONDITION AFTER USED																																	
Letters still good (Tulisan Tidak Berubah)	V	V	V	V	V	V	V	V	V	V		V	V										V	V							V	V	
Letters missing (Tidak Terbaca)																											V	V					
Tulisan Tergerus Sebagian (masih terbaca)			v	v										v	v														V	V			
MARKER INFLUENCE																																	
Demaged the nets																																	
Disturb the operatiopnal			V	V												v	v								V	V							
Affect the quality of the fish																																	
Affect the catch production																																	
No problem	v	v			V	V	v	v	v	v		v	v	v	v			v	v	v	v		v	v			V	V	V	V	V	V	
Other information																																	
Noted: A (Above) ; B (Below)																																	

Catch composition

Daily

Nama	KUB Pirik	KUB Pirik	**Catch (kg)**		
Lama trip	2 hari	2 hari			
Catch (kg)			**Rata-rata**	**Jumlah**	**Komposisi**
TENGIRI	2	5	3.5	7	21.21
GERIK	3	3	3	6	18.18
MANYUNG	5	15	10	20	60.61
TOTAL			16.5	33	100

Weekly

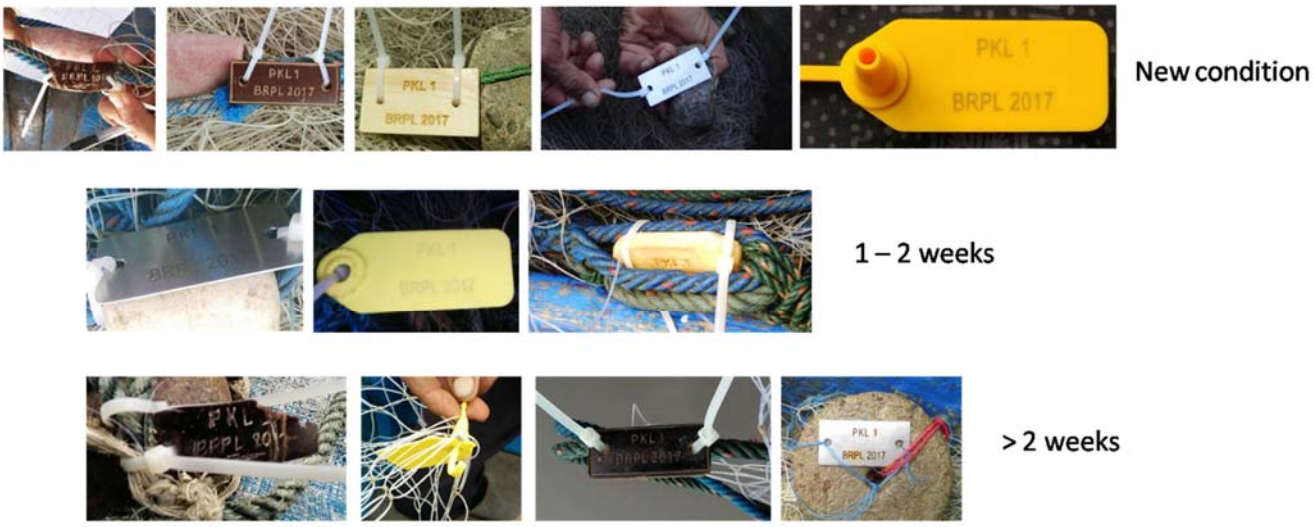
Nama	KUB Lumba lumba	KUB Bawang	KUB Bawang	Catch (kg)		
Lama trip	8 hari	7 hari	7 hari			
Catch (kg)				**Rata-rata**	**Jumlah**	**Komposisi**
TONGKOL ABU-ABU	95	18	49	54	162	10.24
TENGIRI	42	14	28	28	84	5.31
TAWANG	3			3	3	0.19
BAWAL	1		1	1	2	0.13
CUCUT	5	575	362	314	942	59.54
MANYUNG	9		4	6.5	13	0.82
KAKAP MERAH	42	6	6	18	54	3.41
PARI	2		3	2.5	5	0.32
MARLIN	55	44		49.5	99	6.26
LAYARAN	25	8	21	18	54	3.41
KACANGAN	5	7	7	6.3	19	1.20
LEMADANG	18		4	11	22	1.39
REMANG	2			2	2	0.13
PIHI	8	35	11	18	54	3.41
UDUN (Cobia)	7	2		4.5	9	0.57
B KADAL		27		27	27	1.71

GAMBRENG		13		13	13	0.82
PETEK			18	18	18	1.14
TOTAL				594.3	1582	100

CLOSING
The marker is more accepted by fishermen in Pekalongnan is bamboo.

APPENDIX

Potential partners for pilot project - fishers



Marker condition

Appendix 4

Baseline study of ALDFG (abandoned, lost or otherwise discarded fishing gear), on gillnet fisheries: Case Study in Pekalongan and Sadeng (Jogjakarta) Field Report 4

BRPL (and WAP)

BRPL/WAP-ALDFG-012017

ACTIVITIES: 3rd trip survey,
LOCATION: Central Java, Pekalongan (Krapyak).
PARTICIPANT:
1. Erfind Nurdin
2. Baihaqi

TIME: 29 December 2017 - 3 January 2018

INTRODUCTION

The issue of abandoned, lost or otherwise discarded fishing gear (ALDFG) has been a concern for FAO and its Members for many decades. It has been noted that the elaboration of a standard for the marking of fishing gear would be of benefit to coastal States in addressing problems associated with ALFDG. Marking of fishing gear can also be an important mechanism for identifying illegal fishing gears and may assist in meeting various obligations under relevant international instruments whether they are a binding agreement or voluntary guidelines.

The aim of this study was to supervise fisherman recording result from enumerator

RESULT

Institutions visitation
1. Port authority (PPN Pekalongan)
2. Kelompok nelayan

Potential partners for pilot project - fishers
1. Muji (Owner and fisher)
2. M Riyanto (Capt.)

Material marker
1. Metal
2. Plastic
3. Wood
4. Bamboo
5. Coconut shell

Enumerator record

Daily (KUB PIRIK)

MARKER	21-Nov-17											29-Nov-17		13-Dec-17								31-Dec-17										
	Metal (M)		Plastic (P)		Wood (W)		Bamboo (B)		Coconut shell (C)		Other information	Metal (M)		Plastic (P)		Wood (W)		Bamboo (B)		Coconut shell (C)	Other information	Metal (M)		Plastic (P)		Wood (W)		Bamboo (B)		Coconut shell (C)		Other information
	A	B	A	B	A	B	A	B	A	B		A	B	A	B	A	B	A	B	A	B		A	B	A	B	A	B	A	B	A	B	
Lost	v	v	v	v			v	v	v	v	@1-3 buah (P,W,B,C)	v	v	v	v	v	v	v	v	v	v	Philang 3 buah	v	v	v	v	v	v	v	v	v	v	Habis
Demaged (rusak)											Metal (M) dilepas semua											Chilang 4 buah											Sisa yang ada
Ties broken (Tali putus)			v	v			v	v	v	v				v	v																		dicopot nelayan
Broken (patah)																																	
Crooked (bengkok)																																	
Others	v	v									M Dilepas nelayan												v	v	v	v	v	v	v	v	v	v	
LETTERS CONDITION AFTER USED																																	
Letters still good (Tulisan Tidak Berubah)	v	v	v	v	v	v	v	v	v	v	Marker yg masih ada																						
Letters missing (Tidak Terbaca)																																	
Tulisan Tergerus Sebagian (masih terbaca)																																	
MARKER INFLUENCE																																	
Demaged the nets	v	v																															
Disturb the operatiopnal	v	v										v	v			v	v	v	v				v	v	v	v	v	v	v	v	v	v	
Affect the quality of the fish																																	
Affect the catch production																																	
No problem			v	v	v	v	v	v	v	v				v	v					v	v											
Other information											Tali ties mudah putus											Tali ties mudah putus											

Noted: A (Above) ; B (Below)

Weekly (KUB KAWANG)

MARKER	8-14 Nov/2017											20-26 Nov/2017											06-10 Nov/2017 21-22 Des/2017										
	Metal (M)		Plastic (P)		Wood (W)		Bamboo (B)		Coconut shell (C)		Other information	Metal (M)		Plastic (P)		Wood (W)		Bamboo (B)		Coconut shell (C)		Other information	Metal (M)		Plastic (P)		Wood (W)		Bamboo (B)		Coconut shell (C)		Other information
	A	B	A	B	A	B	A	B	A	B		A	B	A	B	A	B	A	B	A	B		A	B	A	B	A	B	A	B	A	B	
Lost					V	V					2 buah			V	V										V	V							M hilang 2
Demaged (rusak)																																	P dilepas semua
Ties broken (Tali putus)																																	W hilang 1
Broken (patah)																															V		B hilang 1 (Patah)
Crooked (bengkok)																																	C hilang 1
Others																																	
LETTERS CONDITION AFTER USED																																	
Letters still good (Tulisan Tidak Berubah)	v	v					v	v	v	v		v	v							v	v		v	v			v	v	v	v	v	v	
Letters missing (Tidak Terbaca)																v	v										v	v					
Tulisan Tergerus Sebagian (masih terbaca)			v	v														v	v														
MARKER INFLUENCE																																	
Demaged the nets																																	
Disturb the operatiopnal			V	V										V	V										V	V							
Affect the quality of the fish																																	
Affect the catch production																																	
No problem	v	v			V	V	v	v	v	v		v	v			V	V	V	V	V	V		V	V			V	V	V	V	V	V	
Other information											Tali ties mudah putus											Tali ties mudah putus											

Noted: A (Above) ; B (Below)

Weekly (KUB LUMBA LUMBA)

	16-Nov-17											9-Dec-17											31-Dec-17										
MARKER	Metal (M)		Plastic (P)		Wood (W)		Bamboo (B)		Coconut shell (C)		Other information	Metal (M)		Plastic (P)		Wood (W)		Bamboo (B)		Coconut shell (C)		Other information	Metal (M)		Plastic (P)		Wood (W)		Bamboo (B)		Coconut shell (C)		Other information
	A	B	A	B	A	B	A	B	A	B		A	B	A	B	A	B	A	B	A	B		A	B	A	B	A	B	A	B	A	B	
Lost					V	V					W hilang 2 buah	V	V	V	V							M hilang semua	V	V	V	V							M hilang semua
Demaged (rusak)																						P hilang 3 buah											P hilang 3 buah
Ties broken (Tali putus)					V	V						V	V	V	V								V	V	V	V							W hilang 2
Broken (patah)																																	B hilang 3
Crooked (bengkok)																																	
Others												V	V									M diputus nelayan	V	V									M diputus nelayan
LETTERS CONDITION AFTER USED																																	
Letters still good (Tulisan Tidak Berubah)	V	V			V	V	V	V	V	V						V	V	V	V	V	V						V	V	V	V	V	V	
Letters missing (Tidak Terbaca)																																	
Tulisan Tergerus Sebagian (masih terbaca)			v	v										V	V										V	V							
MARKER INFLUENCE																																	
Demaged the nets												V	V										V	V									
Disturb the operationnal					v	v						V	V	V	V								V	V	V	V							
Affect the quality of the fish																																	
Affect the catch production																																	
No problem	v	v	v	v			v	v	v	v						V	V	V	V	V	V						V	V	V	V	V	V	
Other information											Tali ties mudah putus											Tali ties mudah putus											

Noted: A (Above) ; B (Below)

Catch composition

Weekly

Name	KUB Lumba lumba	KUB Kawang	KUB Kawang	KUB Kawang	KUB Lumba lumba	KUB Lumba lumba	KUB Kawang (trouble)	KUB Lumba lumba	Catch (kg)		
Day rip	8 hari (9-16 Nov)	7 hari (8-14 Nov)	7 hari (20-26 Nov)	5 hari (6-10 Des)	8 hari (9-16 Des)	8 hari (26-29 Des)	2 hari (26-27 Des)	4 hari (28-31 Des)			
Catch (kg)									Average	Amount	Composition
Tongkol (Bullet tuna)	95	18	49	22	4	17		10	30.7	215	10.00
Spanish mackarel (tenggiri)	42	14	28	16	16	11		5.5	18.9	132.5	6.16
Black pomfret (bawal hitam)	1		1						1.0	2	0.09
Shark (cucut)	5	575	362	3		20		12	162.8	977	45.43
Marine catfish (manyung)	9		4	19	7		1	27	11.2	67	3.12
Baramundi (jenaha/pelak)					7	16		45.5	22.8	68.5	3.19
Kakap merah (red snapper)	42	6	6					18.5	18.1	72.5	3.37
Pari (rays)	2		3						2.5	5	0.23
Setuhuk (black marlin)	55	44							49.5	99	4.60
Layaran (sailfish)	25	8	21	7					15.3	61	2.84
Alu-alu (kacangan)	5	7	7		2	10		3	5.7	34	1.58
Lemadang (dolphinfish)	18		4						11.0	22	1.02
Remang (moray)	2				111		4	6.5	30.9	123.5	5.74
Sebelah (indian halibut)	8	35	11	4	23	9		11	14.4	101	4.70
Cobia (cobia)	7	2				6		1.5	4.1	16.5	0.77
Beloso (lizardfish)		27			10		2	4	10.8	43	2.00
Talang2 (queenfish)	3	13							8.0	16	0.74
Petek (Leiognathidae)			18			23		4	15.0	45	2.09
Semadar (rabbitfish)					4				4.0	4	0.19
Eteman (moonfish)					17				17.0	17	0.79
Kuwe (trevally)								4	4.0	4	0.19
Bentong (bigeye scad)								8	8	8	0.37
Gerot-gerot (Pomadasys)						12	1	4	5.7	17	0.79
Amount	319	749	514	71	201	124	8	164.5			
TOTAL									471.4	2150.5	100.00

Daily

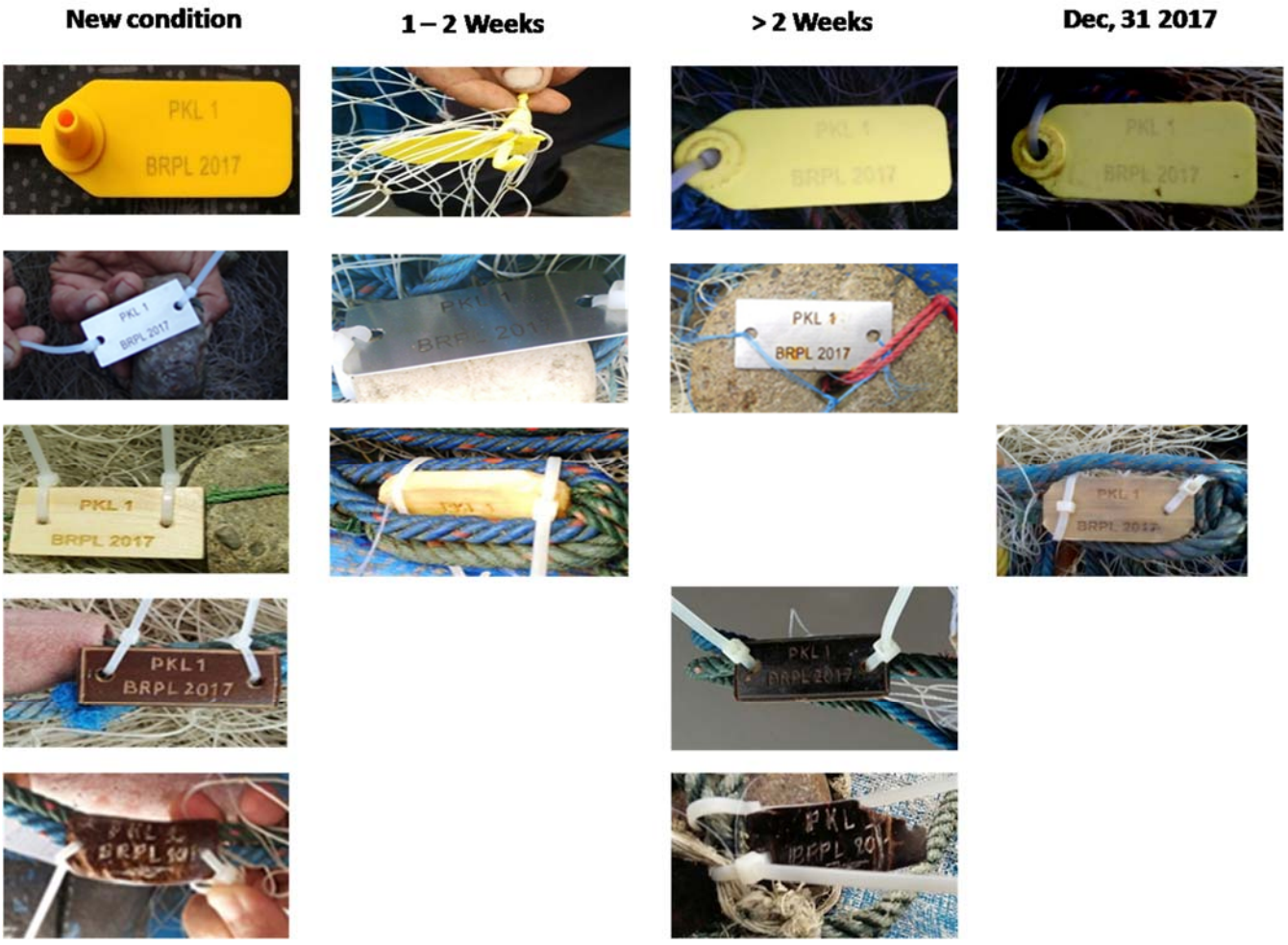
Name	KUB Pink	KUB Pink	KUB Pink	Catch (kg)		
Day trip	2 days (20-21 Nov)	2 days (28-29 Nov)	2 days (13-14 Nov)			
Catch (kg)				Rata-rata	Jumlah	Komposisi
Spanish mackarel (tenggiri)	2	5		3.5	7	12.07
Blotched grunt (Gerot-gerot)	3	3		3	6	10.34
Marine catfish (manyung)	5	15		10	20	34.48
Barracuda (alu-alu)			10	10	10	17.24
Baramundi (jenaha/pelak)			15	15	15	25.86
TOTAL				41.5	58	100.00

CLOSING

Fishermen will receive a marked net with condition that the marker not interfere the operation

APENDIX

Marker condition



Catch













Appendix 5

Survey Questionnaire

Interviewees	
Name (Capt/Owner/Crew)	
Address	
Age (year)	
Fishing experience (year)	
Fishing experience for gillnet (year)	
Arrival date (last trip)	
Interviewer	
Name	
Agency	
Date of interview	
Place of interview	

1	**Fishing gear type (GILLNET)**	**Surface / Mid / Bottom**	**Remark:**

2	**Fleet Unit**		**Remark**
	Vessel		
	Material:		
	Length:	m	
	Breadth:	m	
	Depth:	m	
	Tonnage:	gt	
	Year of Built:		

Main engine Power: hp Maker: Year of manufacture:		
Generator / auxiliary engine Power: hp Maker: Year of manufacture: Function:		
Other equipment Net hauler: hp **Navigation** GPS (maker): Communication radio (maker):		
Crew number: Experience of gillnet operation (average): year		

3	SIZE AND MATERIAL OF GEAR (1 piece)		Remarks
	Net		
	Length:	m	
	Depth:	m	
	Mesh size:	inch	
	Material type:		
	Colour:		
	Selvedge		
	Length:	m	
	Depth:	m	
	Mesh size:	inch	
	Material type:		
	Colour:		
	Head rope and float		
	Length of head rope	m	
	Material type:		
	Colour:		
	Size (diameter):	mm	
	Number of float:	unit	
	Float material:		
	Type/ and size of floats:		
	Space between float:	cm	
	No. meshes between floats:	unit	
	Ground rope and sinker		
	Length of ground rope	m	
	Material type:		
	Colour:		

	Size (diameter):		
	Number of sinker:	unit	
	Sinker material:		
	Type/ and size of sinker:		
	Space between sinker:	cm	
	Number of net mesh between sinker:	unit	
	Buoy		
	Type:		
	Material:		
	Colour:		
	Size:	cm	
	Number:	unit	
	Buoy line		
	Material:		
	Colour:		
	Length:	cm	
	Diameter:	cm	
	Main sinker (anchor)		
	Material:		
	Weight:	kg	
	Rope of Main sinker (anchor)		
	Material:		
	Colour:		
	Length:	m	
	Diameter:	mm	

4	**Fishing Operation** ***Fishing Ground***		**Remarks**
	Position:	S	
		E	
	Substrate type:		
	Distance from fishing base*:*	mile	
	Travel time from fishing base:	hour	
	Depth:	m	
	Operational		
	How long for a Trip	day	
	Effective operational	day	
	Net		
	Number of net that operated:	pieces	
	Number of net that brought into the sea:	pieces	
	Number of net owned:	pieces	

5	FISHING GEAR OPERATIONAL		Remarks
	Setting number per day:	times	
	Setting number per trip:	times	
	Setting start:	am/pm	
	Setting time:	hour	
	Soaking time:	hour	
	Hauling time:	hour	

6	MARKER (Yes/No)	Number	Position
	Flag	unit	
	Buoy/Sinker	unit	
	Label:	unit	
	Twine colour:	unit	
	Light:	unit	
	Other:		

Reason conducted marker:

Marker Installation technique:

How many times gear lost in a year:

How retrieved:

Retrieval opportunity:

How the gear loss (choice - √)

Weather

Gear conflict	
Stolen	
Weathered	
Other (explain)	
When the gear loss, report to whom:	
Fisher perception when the gear loss:	
Fisher opinion about gear marking:	

7	FISH PRODUCTION		Remark
	Catch (kg/setting):	kg	
	Catch (kg/day):	kg	
	Catch (kg/trip):	kg	
	Main target species:		
	Catch composition:		
	1.	kg	
	2.	kg	
	3.	kg	
	4.	kg	
	5.	kg	
	6.	kg	

8	FISH HANDLING		Remark
	Dry		
	How long:	hour	
	Salty		
	Salting time:	hour	
	Salt needs per trip:	kg	
	Ice		
	Ice type (box, piece, bulk):		
	Ice needs per trip:		
	Refrigerator room		
	Capacity:	kg	

9	FISHING SEASON		Information
	Is catch production affected by season?		
	Peak production (month):		
	Average production per trip:	kg	
	Medium production (month):		
	Average production per trip:	kg	
	Poor production (month):		
	Average production per trip:	kg	

10	PROTECTD FISH	Information
	Treatment to protected fish (if any):	

11	INCOME	Information
	Salary Per trip: Rp. Per month: Rp. **Profit-sharing system** Percentage:	

Appendix 6

Photographs related to the project






Interviews with fishing community in Pekalongan

Current methods for marking gillnets in Pekalongan - flashlights and flags for visibility

Lobster gillnet fishery in Sadeng

This report describes a pilot project to test means and methods of marking gillnets in accordance with FAO's *Draft Guidelines on the Marking of Fishing Gear ('the Draft Guidelines')* and to explore the scope for a retrieval and recycling scheme. The pilot study was conducted in Indonesia small-scale gillnet fisheries. The study found that the availability of environmentally friendly materials for markers and fisher safety when operating gear with physical markers were both key issues. The study also found that gear marking must be implemented in the context of broader measures for managing fishing gear and wider fisheries management measures as gear marking alone is unlikely to solve the issues of abandoned, lost or otherwise discarded fishing (ALDFG) and ghostfishing that are apparent in Indonesian small scale-scale and probably other similar fisheries, particularly in developing countries. Such measures could include fisher education and awareness raising, capacity building in general, spatial management of fishing effort and a circular economy approach to managing end-of-life gear.